EXHIBIT C

Prior Art of Record

Bound Separately

PATENT
ATTORNEY DOCKET NO. 09934/004001

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Patentee	:	Charles W. Dunmire et al.
Patent No.	:	5,385,166
Serial No.	:	046,337
Issued	:	January 31, 1995
Filed	:	April 12, 1993
Title	:	BACKFLOW PREVENTOR WITH ADJUSTABLE OUTFLOW DIRECTION

BOX REEXAM
Assistant Commissioner for Patents
Washington, DC 20231

EXHIBIT C IN SUPPORT OF
REQUEST FOR REEXAMINATION

Date of Deposit August 3, 1998
I hereby certify under 37 CFR 1.8(a) that this correspondence is being deposited with the United States Postal Service as **first class mail** with sufficient postage on the date indicated above and is addressed to the Assistant Commissioner for Patents, Washington, D.C. 20231.

JoAnne Boyle
Joanne Boyle

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	213,394	3/1879	Cornwall
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	751,210	2/1904	Smith
	825,499	7/1906	Sturtevant
	980,188	1/1911	Blauvelt
	1,031,642	7/1912	Haase
	1,399,791	12/1921	Pierson
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"Model RP-1 Backflow Preventor", Clayton Automatic Valves, pp. 88-89. Date Unknown.

UNITED STATES PATENT OFFICE.

GEORGE CORNWALL, OF NEW YORK, N. Y.

IMPROVEMENT IN SEWER PIPE AND TRAP.

Specification forming part of Letters Patent No. **213,394**, dated March 18, 1879; application filed February 8, 1879.

To all whom it may concern:

Be it known that I, GEORGE CORNWALL, of the city, county, and State of New York, have invented certain new and useful Improvements in Sewer Pipe and Trap, of which the following is a specification:

The object of my invention is to produce a sewer-pipe in which the several sections may be readily and securely connected together, and which is provided with traps of simple construction for preventing gases from flowing back through the pipe.

My invention consists in the novel combination of a hinged trap or traps with a sewer-pipe made of flanged taper sections, whereby a very effective provision is made for the passing off of solid substances through the pipe, and yet the entrance of gases from the sewer through the pipe to the interior of a building is effectually prevented.

In the accompanying drawings, Figure 1 represents a longitudinal section of a portion of a sewer-pipe embodying my invention, and Fig. 2 an end view of one of the sections thereof and a face view of a valve hinged thereto.

Similar letters of reference designate corresponding parts in both figures.

A designates the sections of which the sewer-pipe is composed. They are preferably made of cast-iron, and are provided upon one end with a flange, *a*.

In order to provide for inserting the flanged end of each section in the next section, I make each section internally tapering toward the flanged end for a portion or the whole of its length, and of such size as to receive snugly within it the flanged end of the preceding pipe, which is pushed into the same until the flange touches upon all sides. The joint may then be completed by filling in outside said flange with cement or other like material, as here represented, making a water and gas tight joint. The sections A are arranged on an incline, and the flange at the end of each pipe makes a slight fall as the water flows through the pipe, as represented at *d*, and thus prevents the accumulation of solid matter.

In order to prevent the flow of gas backward through the said pipe, I employ valves B, hinged to the outer or flanged end of one or more sections, and closing against the outer end thereof, so as to be opened by the flow of water through the said pipe, as represented in dotted outline in Fig. 1, and closed by their own weight. As the valves close against the ends of the sections they are not obstructed in their action by any solid matter passing through the pipe.

I have represented the flanged face of each section as provided with lugs *b*, and the valve as provided with lugs *c*, hinged to the face of the section by the lugs *b*. By providing sections of pipe with these valves gases are precluded from flowing back through the pipe and entering the building with which the sewer-pipe is connected.

In order to permit the valve B to open properly, I preferably make the pipe rectangular in its cross-section; but, if desirable, it may have a rounded bottom with straight sides.

By my invention I produce a sewer-pipe which may be very cheaply and strongly constructed, and by which the danger to health resulting from the presence of sewer-gas in a building is prevented.

What I claim as my invention, and desire to secure by Letters Patent, is—

The combination, with a sewer-pipe composed of internally-tapering sections provided upon the smaller ends with flanges, of a valve or valves hinged to the flanged ends of one or more sections, so as to be opened by the flow of water through the said pipe and closed by their weight, substantially as specified.

GEO. CORNWALL.

Witnesses:
T. J. KEANE,
FRED. HAYNES.

G. CORNWALL.
Sewer Pipe and Trap.

No. 213,394 Patented Mar. 18, 1879.

Fig 1.

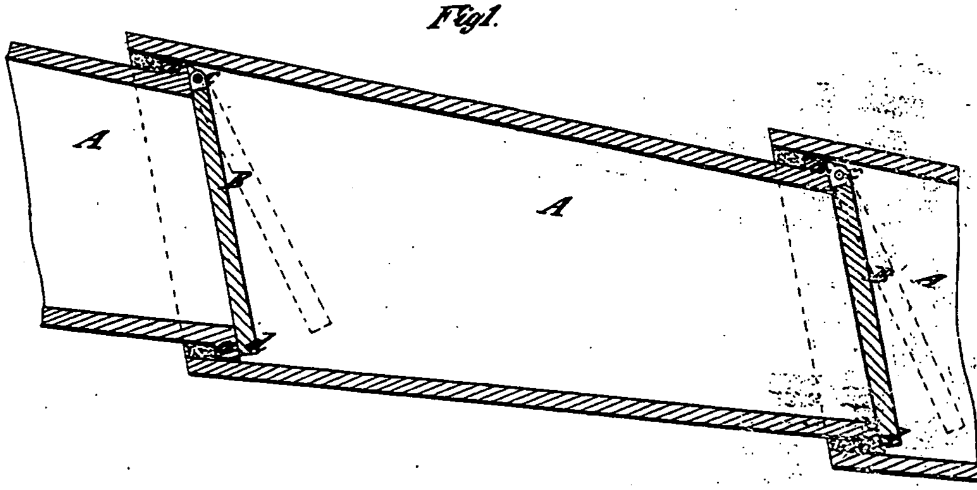
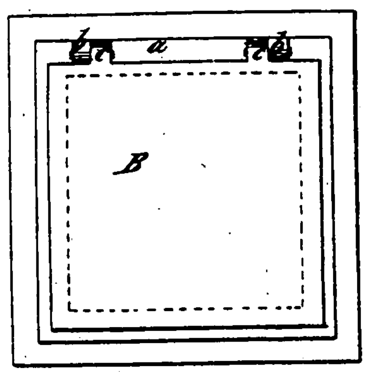


Fig 2.



Witnesses:
Fred. Haynes
Edw. P. Jessup

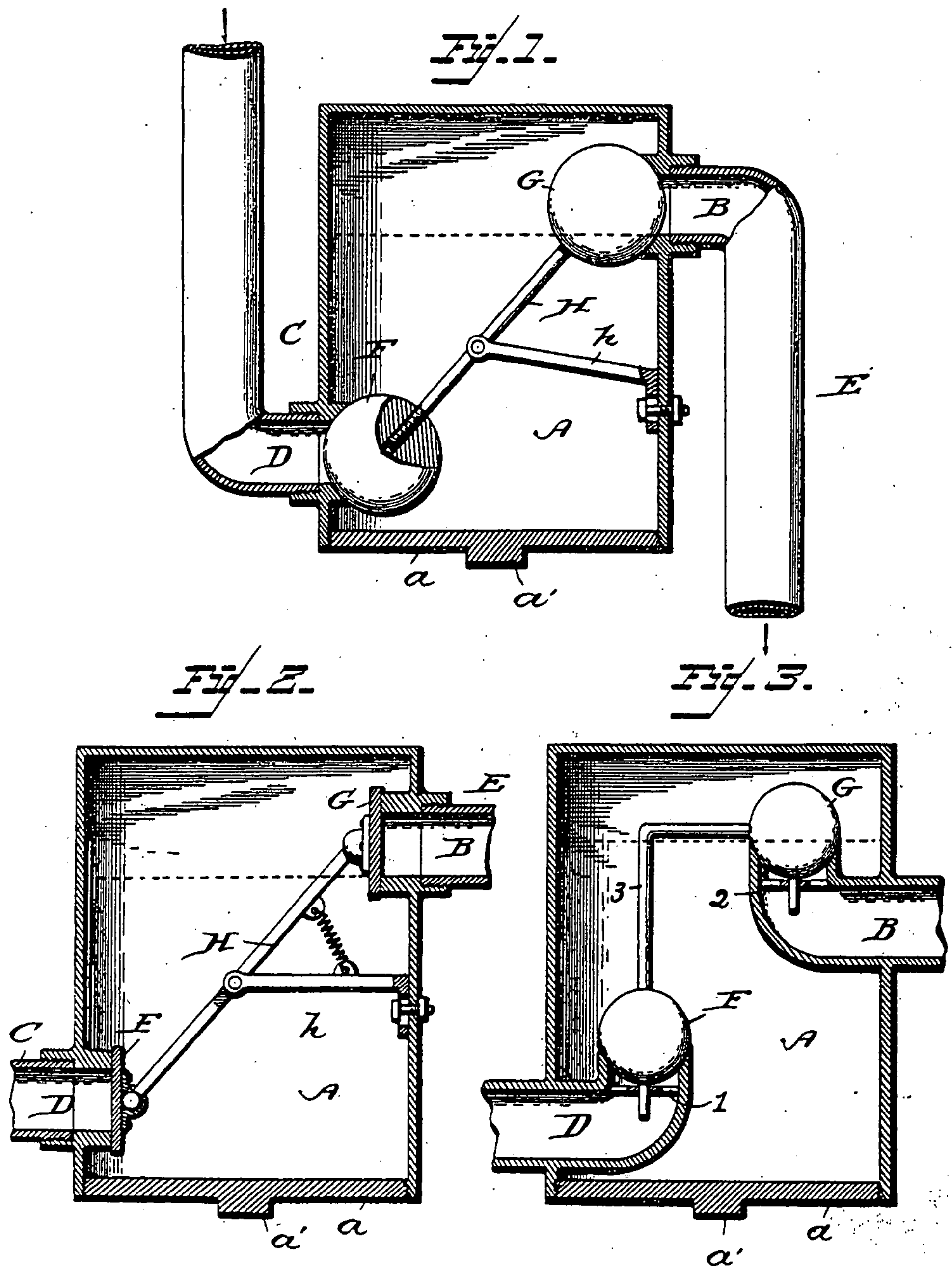
Inventor:
George Cornwall
by his Attorneys
Brown & Brown

(No Model.)

P. FALKINBURG.

TRAP FOR BASINS, SINKS, &c.

No. 510,503. Patented Dec. 12, 1893.



Witnesses

Albert Speiden

Van Buren Hillyard.

Inventor

Percy Falkinburg.

By Attorneys R. S. & A. P. Lacey

UNITED STATES PATENT OFFICE.

PERCY FALKINBURG, OF ATLANTIC HIGHLANDS, NEW JERSEY, ASSIGNOR OF ONE-HALF TO NATHANIEL H. ROBERTS, OF SAME PLACE.

TRAP FOR BASINS, SINKS, &c.

SPECIFICATION forming part of Letters Patent No. 510,503, dated December 12, 1893.

Application filed March 8, 1893. Serial No. 465,072. (No model.)

To all whom it may concern:

Be it known that I, PERCY FALKINBURG, a citizen of the United States, residing at Atlantic Highlands, in the county of Monmouth, State of New Jersey, have invented certain new and useful Improvements in Traps for Basins, Sinks, &c.; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to traps for sinks and basins, and has for its object to provide a water seal and two valves for the purpose of excluding sewer gas.

The improvement consists, essentially, of a case having an inlet at its lower end and an outlet at its upper end, and a lever carrying valves on opposite sides of its pivotal point to close the said inlet and outlet when the trap is inactive.

The improvement also consists of the novel features and the peculiar construction and combination of the parts which will be hereinafter more fully described and claimed and which are shown in the annexed drawings, in which—

Figure 1 is a detail view, partly in section, of the invention. Fig. 2 shows a modified form of valve for closing the inlets. Fig. 3 shows a further modification in which the valves and the valve connecting rod are adapted to have a vertical movement.

The case A is closed and may have any desired form and be constructed of suitable material. In the preferred form of construction the case is cylindrical in cross section and is constructed of either brass, copper or lead tubing. For purposes of cleaning the lower end of the case is closed by a removable head *a* which is adapted to be screwed on the case. A projection *a'* extends from the head *a* to receive a wrench or other instrument by means of which the said head can be turned when screwing it on or off the case A. This case A is provided at its upper end with an outlet B and near its lower end with an inlet D. Both the inlet and outlet are formed in the side of the case close to the ends thereof and are provided with valve seats. These valve seats project on opposite sides of the body portion of the case to prevent matter adhering to the inner sides of the case from interfering with the seating of the valve and also to provide means of attachment to the case of the inlet and the outlet pipes C and E, respectively. The valves F and G close, respectively, the inlet and the outlet and are attached to the opposite ends of a lever H which is pivotally supported between its ends. The valves and lever are so constructed and disposed that the valve G and the upper portion of the lever H will overbalance the valve F and the lower portion of the lever whereby the superior weight of the valve G and upper portion of lever H will cause the seating of the valves F and G under normal conditions. It will be observed that the inlet and outlet are disposed at diagonally opposite ends of the case. Hence the lever H will occupy a corresponding diagonal position in order to seat the valve.

The manner of supporting the lever H is not essential and will depend upon the skill of the workman. As shown the lever is supported on the outer end of a rod *h* which is projected from the side of the case. This rod may be attached to the case in any desired manner, but it is preferred to have it form part of a bracket which is adjustably connected to the case so that the relative position of the lever may be adjusted within certain limits to accurately seat the valves F and G. To further allow for differences in mechanical construction the valves F and G may be adjustably connected with the ends of the lever H. The simplest form of construction for adjustably connecting the valves with the said lever is that shown in which the ends of the lever will be threaded and the valves correspondingly threaded and adapted to screw on the threaded ends of the latter.

The precise construction of valve is not essential. They may be flat, as shown in Fig. 2, or ball valve, as shown in Fig. 1. The latter form is preferred. Where the valves are flat, as shown in Fig. 2, they will be connected with the lever by a ball and socket joint which will admit of the valves adapting themselves to their seats so as to obtain a close joint.

In practice the trap will be arranged sub-

stantially as shown in Fig. 1 and under normal conditions both the valves will be seated. As the water or other fluid enters the case through the inlet D the valve F will be unseated by the force of the incoming water. The valve G by reason of its connection through lever H with the valve F will at the same time be moved away from its seat and permit the water or fluid in the trap to escape through the outlet B. The instant the water ceases to enter the trap through the pipe C, the valves F and G will close their respective inlets and exclude noxious odors. The upper portion of the case will contain air and the lower portion water, the latter forming a water seal as is usual in devices of this nature. In some instances it may be expedient to provide a spring to operate on the lever H to insure a seating of the valve. This construction is indicated in Fig. 2.

In Fig. 3 the valves F and G are adapted to have a vertical movement and are guided in their movements by depending extensions which are adapted to work in openings formed in the cross bars 1 and 2 extending across the inlet and outlet. These valves are connected by a rod 3 so as to cause them to operate simultaneously.

Having thus described my invention, what I claim, and desire to secure by Letters Patent, is—

1. A trap for basins, stands &c. comprising a closed case having an inlet at the lower end and an outlet at the upper end, the inlet and the outlet being diagonally disposed, valves for closing the said inlet and the outlet, and a single lever pivotally supported between its ends and extending diagonally within the case and having the said valves attached to its opposite ends, the weight of the upper valve being superior to cause the seating of the valves, substantially as described.

2. A trap for basins, stands &c. comprising a closed case having an inlet at its lower end and an outlet at its upper end and a lever adjustably supported between its ends and provided with valves to close the said inlet and outlet, substantially as described.

3. The herein described trap for basins, stands &c. comprising a closed case the lower end of which is removable, and having an inlet at the lower end and an outlet at the upper end, and a lever pivoted between its ends, and having ball valves at its opposite ends to close the said inlet and outlet, the upper valve overbalancing the lower valve for the purpose of effecting a seating of the said valves, substantially in the manner set forth.

In testimony whereof I affix my signature in presence of two witnesses.

PERCY FALKINBURG.

Witnesses:
E. H. COOK,
D. L. CONOVER.

No. 751,210. PATENTED FEB. 2, 1904.

W. H. SMITH.

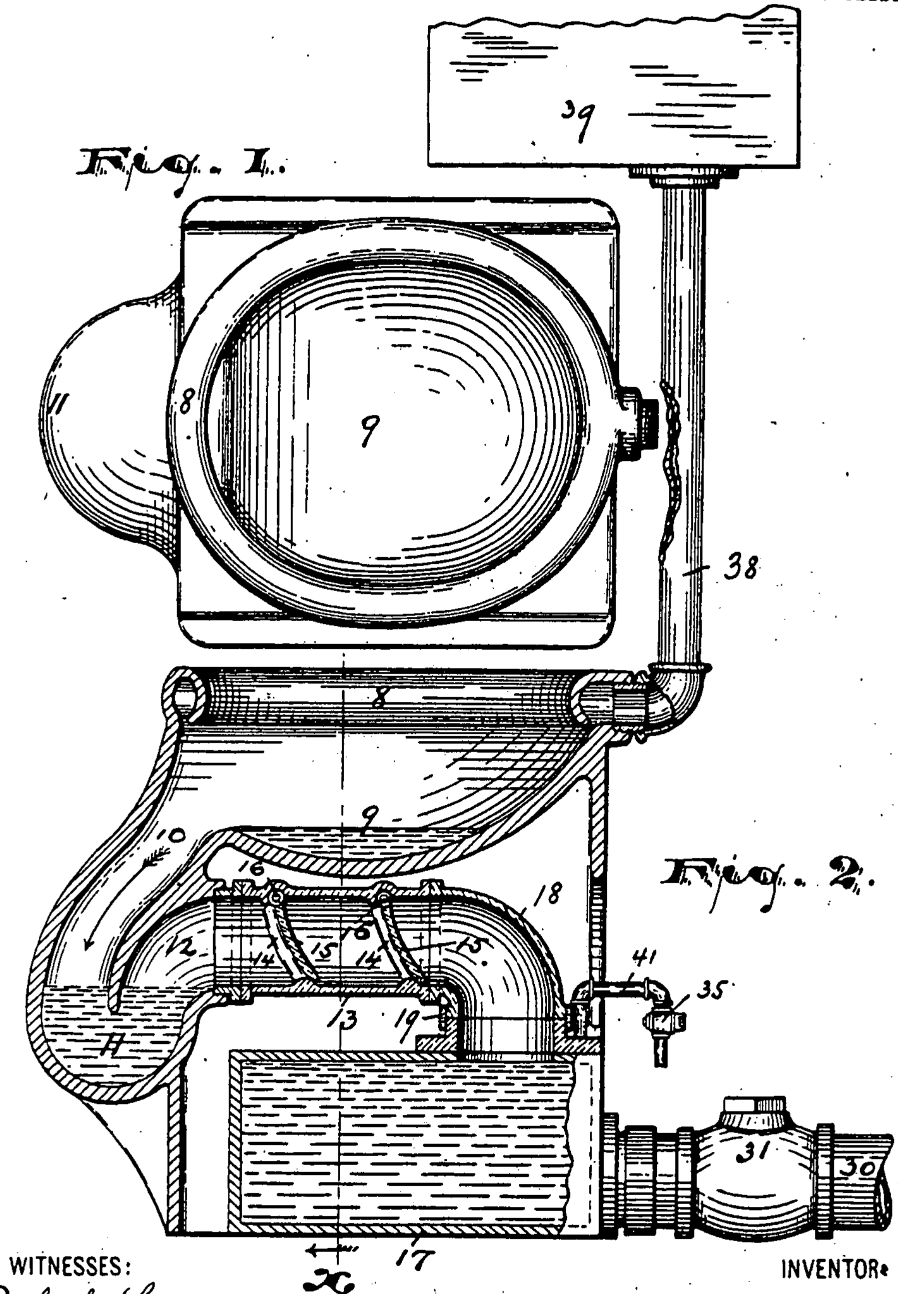
AUTOMATIC MARINE WATER CLOSET.

APPLICATION FILED APR. 13, 1903.

NO MODEL. 3 SHEETS—SHEET 1.

Fig. 1.

Fig. 2.



WITNESSES:

Ralph Lancaster.

Russell M. Everett.

INVENTOR.

William H. Smith,

BY

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THE NORRIS PETERS CO. PHOTO-LITHO., WASHINGTON, D. C.

No. 751,210. PATENTED FEB. 2, 1904.

W. H. SMITH.

AUTOMATIC MARINE WATER CLOSET.

APPLICATION FILED APR. 13, 1903.

NO MODEL. 3 SHEETS—SHEET 2.

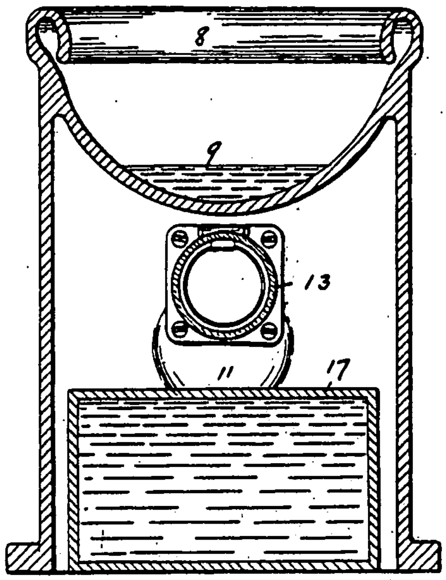


Fig. 3.

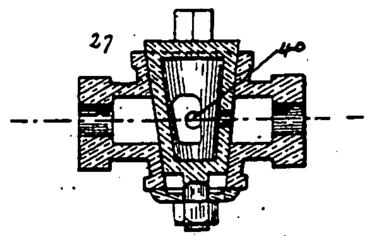


Fig. 5.

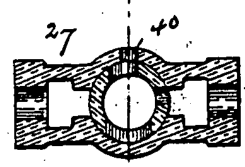
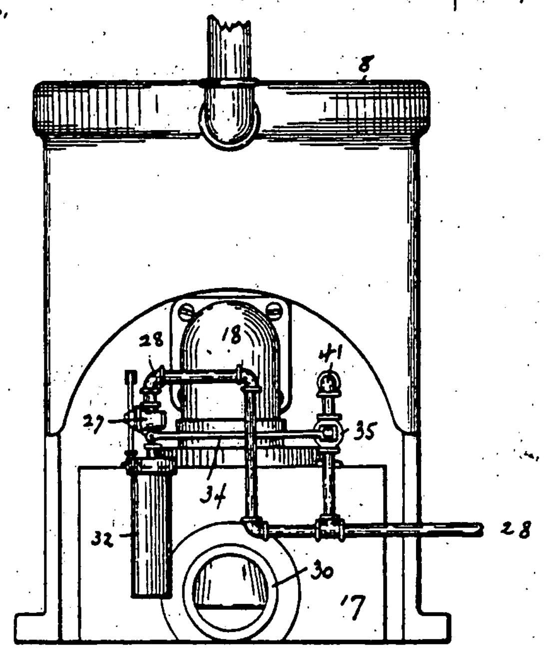


Fig. 6.

Fig. 4.



WITNESSES:

Ralph Lancaster.

Russell M. Everett.

INVENTOR:

William H. Smith,

BY

Charles H. Pell,

ATTORNEY.

No. 751,210. PATENTED FEB. 2, 1904.

W. H. SMITH.

AUTOMATIC MARINE WATER CLOSET.

APPLICATION FILED APR. 13, 1903.

NO MODEL. 3 SHEETS—SHEET 3.

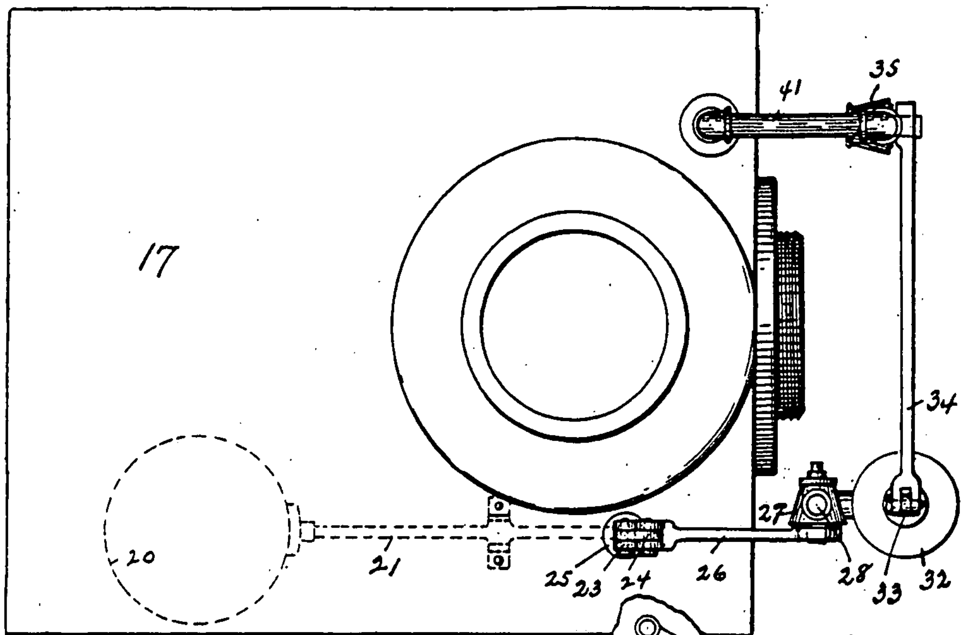


Fig. 7.

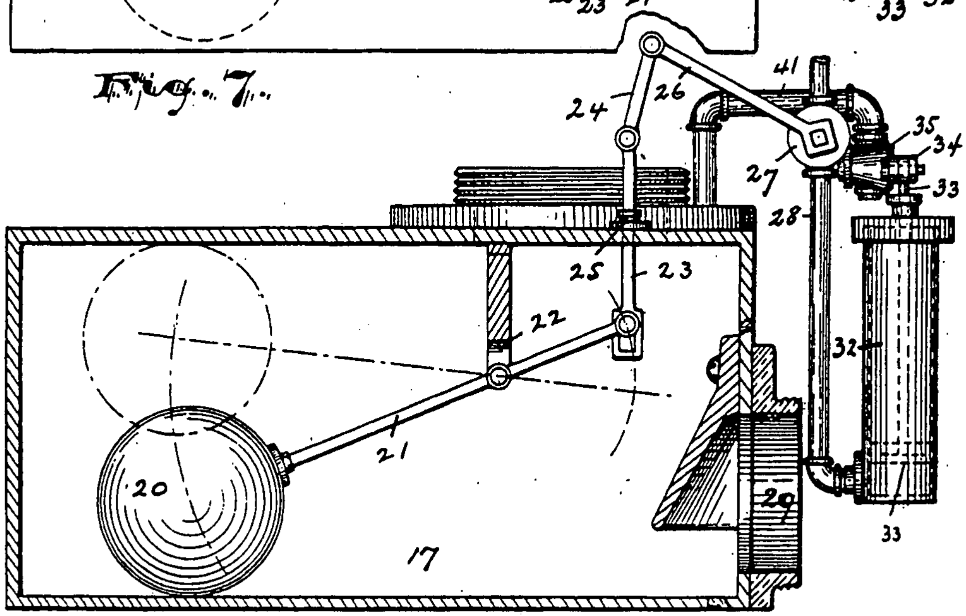


Fig. 8.

WITNESSES:

Ralph Lancaster.

Russell M. Everett

INVENTOR:

William H. Smith,

BY

Charles H. Pell

ATTORNEY.

THE NORRIS PETERS CO. PHOTO-LITHO. WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

WILLIAM H. SMITH, OF ELIZABETH, NEW JERSEY, ASSIGNOR OF ONE-HALF TO WALTER F. KELLY, OF ELIZABETH, NEW JERSEY.

AUTOMATIC MARINE WATER-CLOSET.

SPECIFICATION forming part of Letters Patent No. 751,210, dated February 2, 1904.

Application filed April 13, 1903. Serial No. 152,379. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM H. SMITH, a citizen of the United States, residing at Elizabeth, in the county of Union and State of New Jersey, have invented and produced a new and original Improvement in Automatic Marine Water-Closets; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to numerals of reference marked thereon, which form a part of this specification.

The objects of this invention are to enable marine water-closets or water-closets employed in boats or floating vessels, and particularly the closets which are stationed in the vessel below the surface level of the surrounding water, to be flushed with greater convenience and ease, to avoid the labor and inconvenience of hand-pumping in the operation of forcing the water containing the excrementitous matter out into the open sea or surrounding water, to provide a more simple and durable structure, and to reduce the cost of construction, and to secure other advantages and results, some of which may be referred to hereinafter in connection with the detailed description of the working parts.

The invention consists in the improved marine water-closet, in the means employed for automatically supplying compressed air thereto, and in the arrangements and combinations of parts of the same, all substantially as will be hereinafter set forth, and finally embraced in the clauses of the claim.

Referring to the accompanying drawings, in which like numerals of reference indicate corresponding parts in each of the several figures, Figure 1 is a plan of the seat and bowl portion of my improved device. Fig. 2 is a vertical section of the same, showing it in connection with an intermediate tank, the usual flushing-tank, an out-passage pipe adapted to lead the flushed matter from the bowl and also showing certain of the compressed-air connections. Fig. 3 is a section taken on line x of Fig. 2. Fig. 4 shows in rear elevation the intermediate tank or reservoir in connection with the said bowl and compressed-air connections. Figs. 5 and 6 are sectional views of a certain valve hereinafter more fully referred to. Fig. 7 is a detail plan of the intermediate tank or reservoir and certain of the connections, and Fig. 8 is a longitudinal view of the said intermediate tank or reservoir and connections.

In said drawings, 8 indicates the water-closet seat, beneath which are the bowl 9 and down-flow-passage 10 to the trap 11. To the inner extension 12 of the trap is attached a tubular connection 13, having seats 14 14 for a plurality of check or swinging gate valves 15 15, suspended from pivots 16 at the upper side of said connection 13 and arranged and adapted to open under the pressure of fluid flowing down from the bowl and to automatically close by gravity against their respective seats and be held in impervious relation to said seats under pressure of compressed air in a certain intermediate reservoir 17, arranged beneath said bowl 9, as shown clearly in Fig. 2. Said valved extension 13 is preferably connected to the top of the receptacle 17 by an elbow 18 and a threaded collar 19, the elbow and the reservoir being suitably threaded to receive said parts and form an impervious joint.

The interior of the reservoir 17 is of a size sufficient to receive a float 20, Fig. 8, and lever 21, fulcrumed on a suitable bearing 22 in said reservoir, and to permit an operation of the same under the power of the rising and falling fluid in said reservoir. The said lever 21 is in connection with connecting-rods 23 and 24, the first extending through a packing-box 25 in the top or other portion of the reservoir, as convenience may dictate, and the second pivoted to the first and to a lever 26 for operating a valve 27 in a compressed-air pipe 28.

At or near the bottom of the reservoir 17 is an exit-opening 29, Fig. 8, at which the out-passage pipe 30, Fig. 2, is imperviously connected, so as to prevent leakage at the joint, the said out-passage pipe 30 being preferably provided with a suitable check-valve 31, Fig. 2, the interior of which is similar to

the construction shown at 14 15 in Fig. 2, by which backflow or inflow from the water surrounding the boat or vessel is prevented.

The air-pipe 28 having been opened by the valve 27, the compressed air received from a suitable reservoir or air-compressor (not shown) is conducted to the cylinder 32. The piston 33 in said cylinder 32 is forced upward to operate the lever 34 of a second valve 35, with which it is connected, turning said valve 35, so that there is an open communication from the compressed-air reservoir, (not shown,) as before stated, directly through the branch pipe 41 of the compressed-air pipe 28 into the tank or reservoir 17. Upon the entrance of the compressed air into the reservoir 17 the pressure thereof tends to more imperviously and perfectly close the valves 15 to force the liquid contents of the said reservoir 17 outward through the outflow passage or pipe 30, thus lowering the level of the water in said reservoir, so that the float 20 is lowered to the position shown in Fig. 8 to close the valve 27. The said reservoir 17 is maintained in its empty condition, so far as water is concerned, until the pipe 38 from the flushing-tank 39 is opened by the usual means to permit the gravitation of the liquid contents therein and flushed, as hereinbefore described. The valve 27 is a three-way valve, as indicated in Figs. 5 and 6, so that when communication from the compressed-air reservoir through the compressed-air pipe 28 is closed at the same time a vent-passage 40 in the said valve 27 is opened to permit the escape of air beneath the piston in the cylinder 32, so that the said piston is allowed to gravitate to its position as shown in Fig. 8, gravitation of the said piston again closing the valve 35 in the compressed-air pipe. It will thus be noticed that compressed air is supplied to the reservoir containing the flushings from the bowl automatically, so that the liquid contents of the tank 17 is forced out through pipe 30 into the surrounding water and hand-labor in pumping, as sometimes heretofore performed, is avoided.

Having thus described the invention, what I claim as new is—

1. The combination with the bowl, a flushing-tank and connections, of a reservoir adapted to receive the flushings from the bowl, said reservoir containing a float in connection with a valve of a compressed-air pipe, and said compressed-air pipe having said valve, substantially as set forth.

2. The combination with the bowl, flushing-tank and connections, of a reservoir arranged in connection with said bowl to receive the flushing-water therefrom, a float in said reservoir, a valved compressed-air pipe, the valve of which is operated by said float to permit an inflow of compressed air into the said reservoir, substantially as set forth.

3. The combination with the bowl, flushing-tank and connections, of a reservoir arranged in connection with said bowl to receive the flushing-water therefrom, a float in said reservoir, a valved compressed-air pipe, the valve of which is operated by said float to permit an inflow of compressed air into the reservoir, and an out-passage pipe from said reservoir having a valve to prevent backflow, substantially as set forth.

4. The combination with the bowl, flushing-tank and connecting-pipe, of a reservoir arranged below the said bowl in trapped connection with the same, the connections being provided with check-valves, a float in said reservoir in connection with a valve of a compressed-air pipe, said compressed-air pipe having said valve, a cylinder 32, in connection with said pipe, a piston in said cylinder and connections of said piston with a second valve governing the flow of the compressed air through the compressed-air pipe into the said reservoir, substantially as set forth.

5. The combination with the bowl, flushing-tank, reservoir and connections, of a cylinder and branched compressed-air pipe leading the air into said reservoir and cylinder, the branches of the pipe each being provided with valves, and a float and connections controlling said valves, substantially as set forth.

6. The combination with the bowl, flushing-tank and reservoir and connections, of a cylinder and compressed-air pipe leading the air into said reservoir and cylinder, the branches of the pipe each being provided with valves and a float arranged in said reservoir, connecting-rods 23, and 24, and lever 26, connecting with valve 27, a piston arranged in said cylinder and a lever connecting said piston with the valve 27, substantially as set forth.

7. In a water-closet, the combination with a reservoir adapted to receive the flushing-water, of a float adapted to be raised by the flushing-water to open a compressed-air valve, a compressed-air pipe having said valve and means controlling a second valve whereby said means are operated by the compressed air entering through the first said valve said operating means will open said second valve, and said second valve controlling the flow of compressed air into said reservoir, substantially as set forth.

In testimony that I claim the foregoing I have hereunto set my hand this 27th day of March, 1903.

WILLIAM H. SMITH.

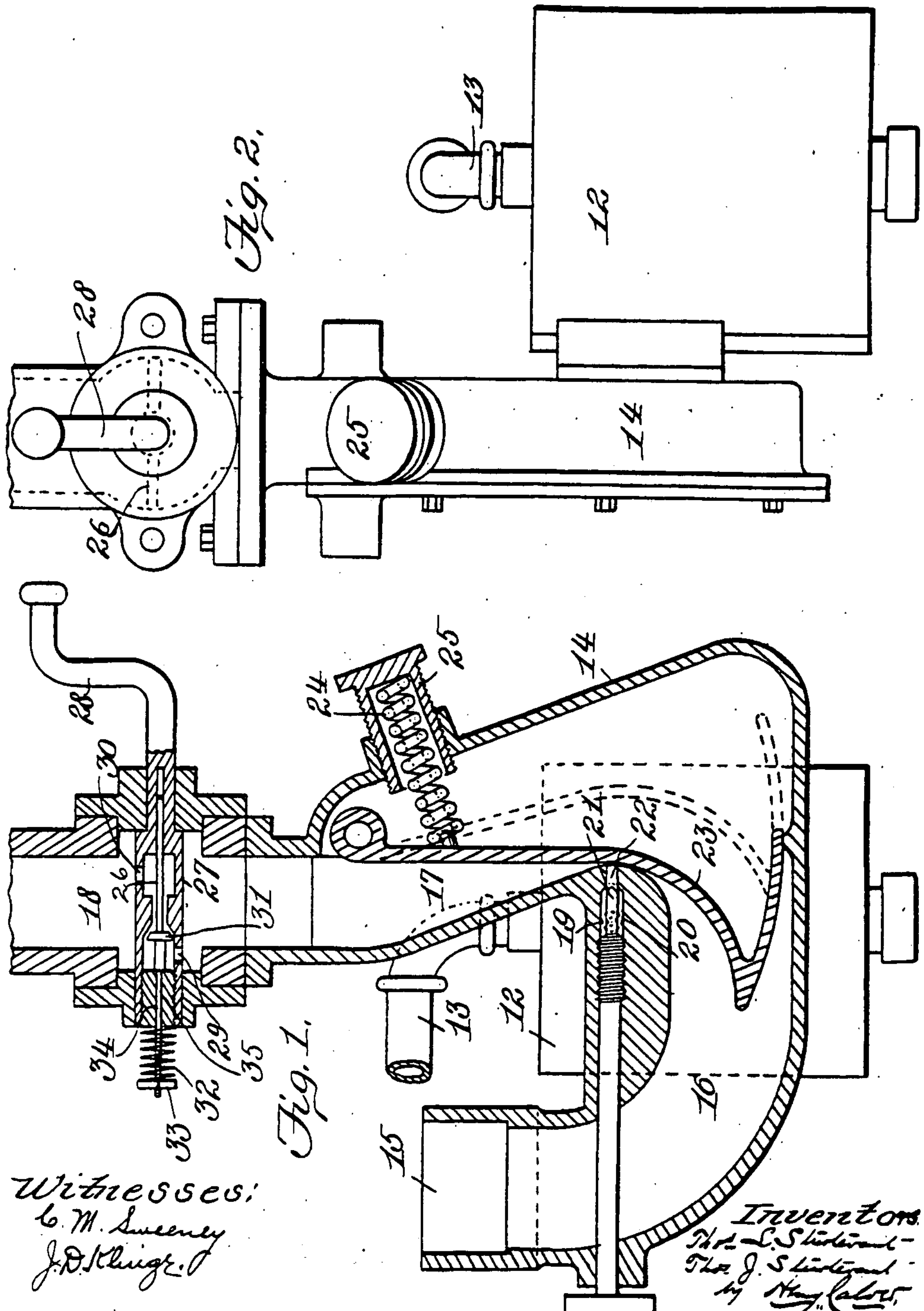
Witnesses:
CHARLES H. PELL,
C. B. PITNEY.

No. 825,499. PATENTED JULY 10, 1906.

T. L. & T. J. STURTEVANT.

CARBURETER FOR GAS ENGINES.

APPLICATION FILED JULY 6, 1905.



Witnesses:
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J. D. Kluge.

Inventors
Thos. L. Sturtevant
Thos. J. Sturtevant
by Henry Calver, Attes.

UNITED STATES PATENT OFFICE.

THOMAS LEGGETT STURTEVANT, OF QUINCY, AND THOMAS JOSEPH STURTEVANT, OF WELLESLEY, MASSACHUSETTS, ASSIGNORS TO STURTEVANT MILL COMPANY, OF BOSTON, MASSACHUSETTS, A CORPORATION OF MAINE.

CARBURETER FOR GAS-ENGINES.

No. 825,499. Specification of Letters Patent. Patented July 10, 1906.

Application filed July 6, 1905. Serial No. 268,323.

To all whom it may concern:

Be it known that we, THOMAS LEGGETT STURTEVANT, residing at Quincy, and THOMAS JOSEPH STURTEVANT, residing at Wellesley, in the county of Norfolk and State of Massachusetts, citizens of the United States, have invented or discovered certain new and useful Improvements in Carbureters for Gas-Engines, of which the following is a specification, reference being had therein to the accompanying drawings.

In the use of explosion or gas engines more or less difficulty has been encountered by reason of the fact that it has been found to be difficult if not impossible to maintain at all times the proper proportion of air and hydrocarbon spray for the gaseous-fuel mixture at different speeds of the engine, and particularly so when engines are running at very slow speeds and when the consequent suction for drawing in the liquid fuel is comparatively slight.

This invention has for its object to avoid the difficulty referred to by providing in a carbureter automatic means whereby when a relatively small volume of air is drawn into the carbureter and the engine is running slowly the passage-way for the air past the spray-nozzle or the inlet for the liquid hydrocarbon fuel will be reduced in area, so that the velocity of the air past the said spray-nozzle or fuel-inlet will at all times be great enough to effect a proper spraying of the fuel. In other words, there is always a rapid current of air sucked past the fuel-inlet, so as to spray the entering fuel properly.

The invention also comprises an automatic governor or governing-valve for the by-pass which permits the passage of gaseous fuel to the engine or motor when the throttle-valve is closed, so that when the engine or motor is running at a very slow speed by virtue of the fuel-supply admitted through the by-pass such slow speed may be automatically regulated, and thus the engine at such times will be prevented from running too fast or too slow.

In the accompanying drawings, Figure 1 is a partial vertical section of a carbureter embodying the invention, and Fig. 2 is an elevation of the same looking from the right of Fig. 1.

Referring to the drawings, 12 denotes a float-chamber liquid-fuel receptacle, which may be of ordinary construction and to which the oil or other liquid fuel is fed from the main reservoir through the pipe 13, the fuel in said float-chamber being maintained at a constant level by a float-controlled valve in the usual manner. The main frame 14 of the carbureter, to which the fuel-receptacle is attached, is provided with an air-inlet at 15, communicating by a passage-way 16 with a mixing-chamber 17, which latter opens upward into the exit-passage 18 to the motor. The float-chamber or fuel-receptacle communicates by a passage-way 19 with a small chamber 20, in which is located a needle-valve 21, which regulates the inlet of the liquid fuel passing into the mixing-chamber 17 through the spray-nozzle or fuel-inlet 22.

Located in the mixing-chamber 17 is an automatic vacuum-regulating valve 23, pivoted at its upper end to the carbureter-frame and pressed against by a spring 24, partly housed in a screw-plug 25, which may be adjusted to vary the tension of the said spring, as may be desired. The automatic vacuum-regulating valve 23 is normally held by said spring in the closed position, (shown in full lines in Fig. 1;) but said valve will be moved backward toward or to the position denoted by dotted lines against the stress of the said spring, according to the pressure and volume of the air which may be passing into the carbureter and which volume of air will be in proportion to the speed and consequent suction or partial vacuum induced by the motor or engine.

Located between the mixing-chamber 17 and the exit-passage 18 is a throttle-valve 26, carried by a pivot-stem 27, provided with a crank or handle 28, by which the said throttle-valve may be opened or closed to admit more or less fuel to the engine. A by-pass by which a small quantity of fuel may be admitted to the engine when the throttle-valve is closed, so that the engine may at such times run at a very slow speed, is of course desirable, and in the construction herein shown this by-pass is made through the stem 27 of the throttle-valve and which stem is formed hollow or with an internal chamber provided with an entrance-port 29 and an exit-port 30. Mount-

ed within the said hollow stem of the throttle-valve is a conical governing-valve 31, which is normally held away from its conical seat by a light spring 32, located between the head or nut 33 on the valve rod or stem 34 and a screw-plug 35, through which the said valve rod or stem passes. The head or nut 33 is preferably adjustable on the said rod or stem for the purpose of varying the tension of said spring, and thus adapting the governor-valve to different speeds.

The operation of the invention is as follows: When the engine is running slowly, so that the volume of air drawn into the mixing-chamber by suction is comparatively small, the swinging vacuum-regulating valve 23 will be held by the spring 24 or other suitable means so near to the spray-nozzle or fuel-inlet 22 as to make the passage-way between the end of said nozzle (or the wall in the part in which the passage-way is formed) and the said valve so narrow that the limited volume of air will pass the fuel-inlet with approximately the same velocity that a larger volume of air will pass with the valve moved forward or away from such inlet or nozzle by the inward pressure of the larger volume of air when the engine is running rapidly, and thus the spray of the liquid hydrocarbon drawn inward or induced by the rapidly-moving small volume of air will be such as to maintain about the same proportion of hydrocarbon spray to the air at slow rates of speeds of the engine as at high rates of speed. In other words, the area of the air-passage at the spray-nozzle or fuel-inlet is automatically narrowed or reduced when the suction is light or feeble and is increased when the suction becomes greater, so that the velocity of the air flowing past the said nozzle will be relatively high at all speeds of the engine, and the air-current will always be a rapid one at the said spray-nozzle or air-inlet. This is an important matter in that with carbureters as heretofore usually constructed it frequently occurred that the slowly-moving current of air passing the inlet-nozzle induced so little inspiration that the liquid hydrocarbon was not properly sprayed, so as to produce a proper explosive mixture for the efficient running of the explosion-engine. It will be observed that the fuel-inlet 22 is located a considerable distance above the lower end of the vertically-disposed automatic vacuum-regulating valve 23, the broad face of which is arranged opposite and approximately at a right angle to said fuel-inlet, so that any of the incoming oil or liquid fuel which fails to be instantly vaporized will be sprayed or discharged against the face of the said valve, and as it trickles down the same will be vaporized later by the inflowing air. If, however, there should be any surplus fuel which is not vaporized either instantly at its entrance or as it trickles down the broad face of the regulating-valve, it will be caught in the cup-like chamber or receptacle afforded by the U-shaped form of the carbureter-casing and will be taken up and vaporized later by the air-current. It will be seen that the U-shaped carbureter-casing or hollow frame is closed at its bottom and that the air-inlet passage-way 15 extends downward into the lower part 16 of the chamber of said frame and also that the mixing-chamber 17 extends upward from said lower part. The cup-like receptacle afforded by the U-shaped carbureter-casing affords a safety-receptacle for any surplus or unvaporized oil or other liquid fuel, and thus not only prevents any waste of the same, but effectively avoids any drip from the carbureter, which is seriously objectionable in that the escaping fuel may possibly catch fire, and thus cause serious accidents. The by-pass which supplies fuel to the engine when the throttle-valve is shut off is of such capacity as to permit of the passage of more than enough of the explosive mixture to run the motor or engine at the slow speed, and the governing-valve 31 in the said by-pass will normally be so adjusted as to permit the passage of just about sufficient fuel or explosive mixture to run the engine at the slow speed desired. If, however, the speed of the engine or motor be accelerated, so as to exceed the slow speed desired, the suction due to the volume of explosive mixture flowing through the by-pass will act on the governing-valve 31 and partly or wholly close the same by suction against the stress of the light spring 32, thus checking the speed of the engine or motor until the suction falls below a certain point, when the valve will again be opened by its spring. Thus the by-pass-governing valve 31 will act automatically to maintain any desired slow speed of the engine or motor when the throttle-valve is closed and fuel is supplied to the engine or motor through the by-pass, and the rapid air-current past the fuel-inlet caused by the inward swing of the vacuum-regulating valve 23 to contract the air passage-way results in a proper fuel mixture at the slow speeds of the governed motor. Any desired slow speeds of the engine or motor when running with the fuel supplied through the by-pass may be provided for by varying the tension of the spring 32 by the adjusting-nut 33, as will be understood.

Having thus described our invention, we claim and desire to secure by Letters Patent—

1. In a carbureter provided with a suitable spray-nozzle or fuel-inlet, the combination with a mixing-chamber and an air-inlet passage-way thereto, of an automatic vacuum-regulating valve normally closing said air passage-way at or adjacent said nozzle or inlet and yieldingly mounted so as to open proportionally to the volume of air drawn in by

suction, said valve extending below said inlet or nozzle so as to receive, for subsequent vaporization, any liquid fuel not instantly vaporized.

2. In a carbureter, the combination of a suitable spray or fuel-inlet and an air-inlet passage-way thereto, with a yieldingly-mounted regulating-valve normally closing said air passage-way but which is opened more or less by the inflowing-air, so that the area of the said air passage-way adjacent the said nozzle or fuel-inlet will be in porportion to the volume of the inflowing air due to suction, said valve extending below said inlet or nozzle so as to receive, for subsequent vaporization, any liquid fuel not instantly vaporized.

3. In a carbureter, the combination with a spray-nozzle or fuel-inlet, a mixing-chamber and an air-inlet passage-way thereto, of an automatic vacuum-regulating valve normally closing said air passage-way and between which valve and said nozzle or fuel-inlet the entering air passes to the mixing-chamber, said valve being yieldingly mounted so that the area of the air passage-way adjacent said fuel-inlet will always be in proportion to the pressure or suction, to cause a rapid current of air to pass said spray-nozzle or fuel-inlet at low speeds as well as at high speeds of the enigne or motor, said valve extending below said inlet or nozzle so as to receive, for subsequent vaporization, any liquid fuel not immediately vaporized.

4. In a carbureter, the combination with a suitable spray-nozzle or fuel-inlet, as 22, of a swinging automatic vacuum-regulating valve, as 23, normally closing the air passage-way at or adjacent said fuel-inlet and between which and the said nozzle or inlet the air passes to the mixing-chamber, and which is yieldingly mounted so as to open porportionally to the volume of inflowing air, said valve extending below said inlet or nozzle and toward the passage for the incoming air, so as to receive, for subsequent vaporization, any liquid fuel not instantly taken up or vaporized as it enters the said mixing-chamber.

5. In a carbureter, the combination with a suitable spray-nozzle or fuel-inlet, as 22, of a yieldingly-mounted, vacuum-regulating valve, as 23, normally closing the air passage-way at or adjacent said inlet and between which valve and the said nozzle or inlet the air passes to the mixing-chamber, a spring for moving said valve toward said closed position against the pressure of the inflowing air, and means for regulating or varying the stress of said spring, said valve extending below said inlet or nozzle and toward the passage for the incoming air, so as to receive, for subsequent vaporization, any liquid fuel not instantly taken up or vaporized as it enters the said mixing-chamber.

6. In a carbureter, the combination with a suitable spray-nozzle or fuel-inlet, of a vertically-disposed air-regulating valve located opposite or approximately at a right angle to said nozzle or inlet so as to receive, in liquid form, any fuel discharged against the same and not instantly vaporized.

7. In a carbureter, the combination with a suitable spray-nozzle or fuel-inlet, of a vertically-disposed and yieldingly-mounted air-regulating valve located opposite or approximately at a right angle to said nozzle or inlet so as to receive, in liquid form, any fuel discharged against the same and not instantly vaporized.

8. In a carbureter, a casing or hollow U-shaped frame closed at its bottom to afford a cup-like receptacle and provided with a spray-nozzle or fuel-inlet discharging into the chamber of said casing or frame, combined with a vertically-disposed and yieldingly-mounted air regulating valve normally closing the air passage-way at or adjacent to said spray-nozzle or fuel-inlet and extending below said inlet so as to receive, in liquid form and for subsequent vaporization, any fuel not immediately vaporized as it enters the mixing-chamber.

9. In a carbureter, a casing or hollow U-shaped frame closed at its bottom to afford a cup-like receptacle and provided with a spray-nozzle or fuel-inlet discharging into the chamber of said casing or frame, said chamber comprising an air-inlet passage-way opening downward into its lower part and a mixing-chamber or fuel-exit passage-way opening upward from its said lower part, combined with a vertically-disposed air-regulating valve in said mixing-chamber opposite said fuel-inlet and extending below the latter, so that any liquid fuel not instantly vaporized at its entrance will be received, in liquid form, by said valve, and so that any fuel not vaporized by the incoming air on said valve will be received in said cup-like receptacle for subsequent vaporization.

10. In a carbureter, a casing or hollow U-shaped frame closed at its bottom to afford a cup-like receptacle and provided with a spray-nozzle or fuel-inlet discharging into the chamber of said casing or frame, combined with an automatic or yieldingly-mounted and vertically-disposed air-regulating valve in said chamber and adjacent said spray-nozzle or fuel-inlet, and which receives, in liquid form, the fuel not instantly vaporized, and which cup-like receptacle receives and holds the liquid fuel not vaporized on said valve.

In testimony whereof we affix our signatures in presence of two witnesses.

THOMAS LEGGETT STURTEVANT.
THOMAS JOSEPH STURTEVANT.

Witnesses:
W. H. ELLES,
L. H. STURTEVANT.

UNITED STATES PATENT OFFICE.

ALBERT BLAUVELT, OF CHICAGO, ILLINOIS.

DETECTOR-METER.

980,188. Specification of Letters Patent. Patented Jan. 3, 1911.

Application filed March 21, 1907. Serial No. 363,775.

To all whom it may concern:

Be it known that I, ALBERT BLAUVELT, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a new and useful Detector-Meter, of which the following is a specification.

This invention relates to hydraulic systems, and more particularly to those in connection with which meters are employed. Its principal objects are to provide such a system which will measure a normal quantity of fluid in the usual or any convenient manner, and which will permit a greater flow, as for a fire service, to pass unobstructed by the meter and yet to give an indication of its occurrence.

The drawing shows in vertical section a valve, together with associated apparatus and conduits arranged in accordance with my invention.

The character A designates a section of a main conduit, of such area as to permit the passage of the maximum fluid-flow without undue resistance, and, in the present instance, furnished in part by the casing of a valve or controlling device A′. Attached to the casing are end pieces B and C for connection with the main conduit and furnishing a portion thereof. Opening from separated points in the conduit, here illustrated as joined to the end pieces, is a smaller conduit or by-pass P, in which is suitable meter K.

The valve A′ is preferably of the "check" type, it having a disk D coöperating with an annular seat F secured in place by a nut U contacting with an annular flange U′. The disk may be carried by an arm E pivoted at *e* upon the casing and swinging toward the eduction end of the by-pass to open the valve. The disk is shown as rotatably mounted upon its arm, it turning about a pin J projecting therefrom. About the periphery of said disk are gear teeth T, with which may engage a pinion V carried by a shaft N rotatable in and longitudinally movable through a properly packed opening in the casing. The turning of the valve-disk by its gearing, enables the contacting surfaces between it and the seat to be cleaned. This mechanism need not, however, be particularly described, as it is not important in connection with the present invention.

Pivoted at *a* upon the valve arm is a link *a′* swinging between stops *e′ e″* projecting from the arm laterally of the casing, and having mounted pivotally at *b* at its upper extremity a seat or socket F′. Between F′ and a similar seat R pivoted at *c* depending from the upper portion of the casing, is interposed a spiral spring G which is normally somewhat under compression. At one side of the spring, projecting from the wall of the casing, is a curved abutment H, which, when the spring contacts therewith, compels it to assume a laterally flexed position, this occurring whenever the lower extremity of the spring is situated as indicated in dotted lines at I.

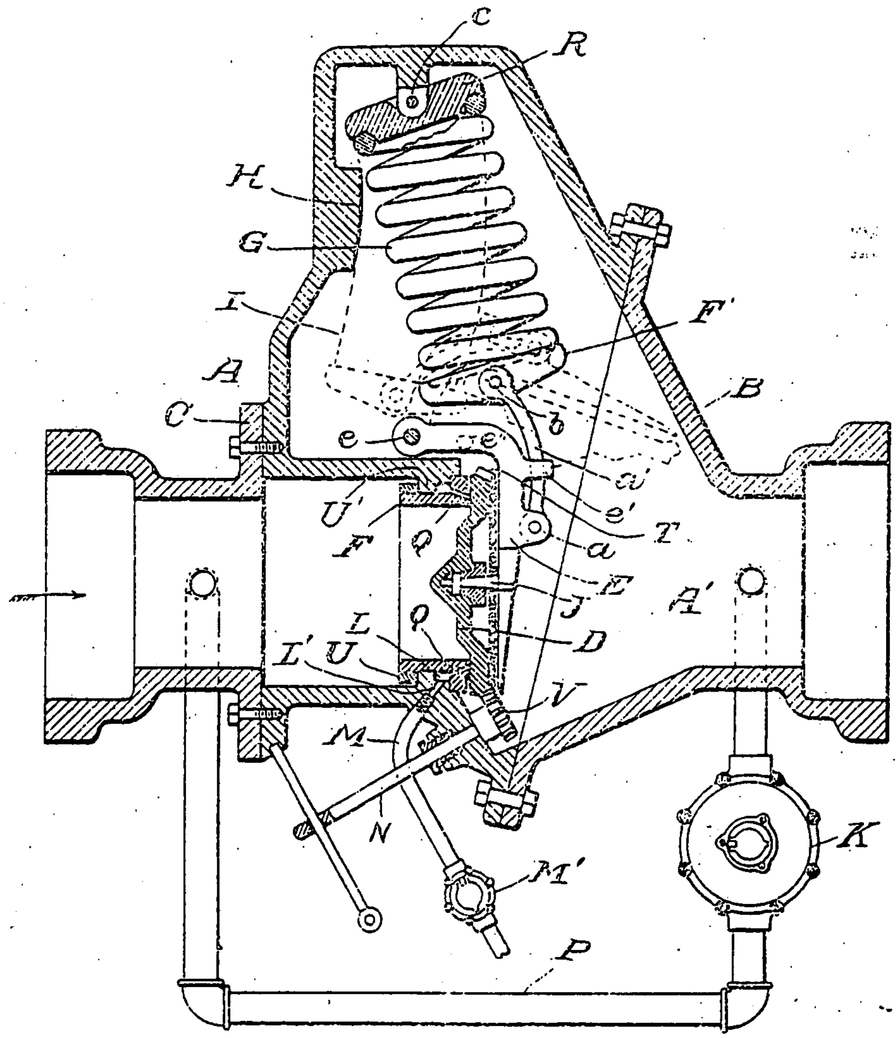
In the valve-seat is a series of passages Q leading from its contact surface with the disk to an annular space or chamber L formed between the seat and the flange U′. This chamber communicates through a passage L′ in the casing with a pipe M, open to the atmosphere but having in it an indicating mechanism through which any discharge occurs, and which in the present instance is in the form of a meter M′.

In the operation of my invention, all the elements are normally as shown in solid lines in the drawing and the passage of the fluid is in the direction indicated by the arrow. The check-disk is pressed against its seat by the spring, which is under sufficient compression to cause more than a normal meter resistance to the fluid-flow, said resistance being introduced by the by-pass. In addition to the force exerted by the spring, the communication of the passages Q with the atmosphere causes an excess of static pressure on the outlet side of the valve, or that toward the eduction opening of the by-pass, because of its greater effective area, said excess pressure being transmitted through said by-pass. This differential assists the spring in keeping the valve normally closed, the proportional pressure exerted by the two forces varying in accordance with the spring-tension, area of valve and openings and the like. The meter K and by-pass therefore offer a less resistance to flow than does the valve, and permit any normal consumption of fluid to occur therethrough and the meter to record it.

Upon an unusual rush of fluid through the system, as might occur for fire-service, the disk will be forced away from its seat by the impact of the fluid and by the excess of pressure at the induction side of the by-pass over that transmitted through it. The first

A. BLAUVELT.
DETECTOR METER.
APPLICATION FILED MAR. 21, 1907.

980,188. Patented Jan. 3, 1911.



Witnesses.
H. A. Hall
Louis B. Erwin

Inventor:
Albert Blauvelt.
by Rector, Hibben & Davis
His Attys.

flow will be in the form of a thin sheet and will exert an opening force effective over the entire area of the disk, which is larger than that presented before the actual opening begins. At the same time the static differential due to the passages Q entirely disappears, therefore any given water pressure capable of starting the disk from its seat will immediately afterward have increased power to force said disk toward its fully open position, against the tension of the spring. As soon as the pivot *a* has traveled somewhat to the right, the pivotal support of the socket F' will be at the left of a line joining the pivots *a* and *c*, and the link *a'* will be free to leave the stop *c'*, with which it normally contacts, and move toward the stop *c''*, thus decreasing the distance between the pivots *b* and *c* and thereby lessening the effective resistance of the spring against the further opening movement of the valve. A very moderate fluid-pressure will thereafter cause the disk to rise to or approach the position shown by dotted lines. Simultaneously with the unseating of the valve, fluid enters the chamber L by the passages Q and is discharged by the pipe M through the meter M'. The flow alone will indicate the existence of a new condition in the system and by calibrating the meter its reading will serve as a record of the length of time that the valve was open, from which may be estimated the fluid passing through the system unmeasured by the normal-service meter K.

The abutment H is designed to force the spring to assume sufficient lateral flexure to follow the downward movement of the disk after the augmented flow of water shall have ceased, and also to swing back the arm E by a sudden impulse to return it to its initial position as soon as the disk shall have approached its seat. Contact between the disk and seat again closes the passages Q, stopping the flow through the detector meter M' and restoring the system to its normal condition.

I claim:

1. The combination with a main conduit, of a by-pass opening therefrom, a valve situated in the main conduit and being provided in its seat with a passage, means for connecting the passage with the atmosphere, a spring for seating the valve, and connections between the valve and spring whereby the resistance of said spring is lessened as the valve moves from its seat.

2. The combination with a main conduit, of a by-pass opening therefrom, a pivoted valve situated in the main conduit and being provided in its seat with a passage, means for connecting the passage with the atmosphere, a spring for seating the valve, and a link joined to the valve and having a pivotal connection with the spring, the distance between the valve and spring pivots decreasing during the opening movement of the valve.

3. A meter system comprising a main conduit, a by-pass opening therefrom, a meter in the by-pass, a casing included in the main conduit and being provided with a valve seat having openings, means for connecting the openings with the atmosphere, a movable valve member pivoted to the casing and coöperating with the seat, a spring, a connection between one extremity of the spring and the casing, and a connection between the other end of the spring and the movable member, the connection between the spring and valve being movable toward the valve member pivot during the separation of said member from its seat.

ALBERT BLAUVELT.

Witnesses:
S. E. HIBBEN,
SYLVIA BLISS.

UNITED STATES PATENT OFFICE

HERMAN G. HAASE, OF MINNEAPOLIS, MINNESOTA.

UNIVERSAL ANGLE-COUPLING AND VALVE-SEAT FOR PIPING.

1,031,642. Specification of Letters Patent. Patented July 2, 1912.

Application filed February 16, 1911. Serial No. 609,028.

To all whom it may concern:

Be it known that I, HERMAN G. HAASE, a citizen of the United States, residing at Minneapolis, in the county of Hennepin and State of Minnesota, have invented certain new and useful Improvements in Universal Angle-Couplings and Valve-Seats for Piping, of which the following is a specification.

My invention relates to a universal coupling for use in connection with piping of every sort and provides means whereby said coupling may be utilized to form a union between two pipes extending in any relative angular direction from ninety to one hundred and eighty degrees (90° to 180°).

It is also an object of my invention to provide in such angle coupling means for coöperation either with a choke valve or check valve, as may be desired. Such an adaptation is rendered practicable by reason of the characteristic and novel features of my universal joint, which features will be described in detail in the specification and particularly pointed out in the claims.

In the drawings illustrating the application of my invention in one form,—Figure 1 is a side elevation of the device having a choke valve applied thereto and with the parts set at ninety degrees (90°). Fig. 2 is a similar view in section. Fig. 3 is an elevation showing the pipes at an obtuse angle to one another. Fig. 4 is a sectional view of the union with the pipes in line and the check valve substituted for the choke valve. Fig. 5 is a plan view from above of the parts shown in Fig. 1 with the valve wheel omitted.

My union comprises a pair of members 8 and 29, member 8 being provided with an interiorly threaded coupling extension, as indicated at 8′, for forming a connection with a pipe 9 and member 29 being provided with a similar interiorly threaded coupling extension 30 for forming connection with pipe 31. Member 8 is provided with an expanded portion 7, said portion being formed with an annular face 7′ surrounding said expanded portion and lying in a plane angularly disposed with respect to the axial center of opening 8′ and pipe 9, the preferred angle, as shown, being forty-five degrees. In the form shown the face 7′ is continued in the upwardly curved portion 24 hereinafter described and from there outwardly upon the surface of a diaphragm 10 which forms an integral part of member 8 and intersects said member at an angle of forty-five degrees to the axial center of coupling extension 8′ and pipe 9, that is, so the face of said diaphragm will lie in a plane parallel to the plane of the face of the member. The member 29 is provided with an expanded portion 21 having an annular face 21′, said face 21′ being in the plane at an angle of forty-five degrees to the axial center of threaded coupling extension 30 and pipe 31. Face 21′ has an upwardly curved portion forming a seat 23 corresponding with the portion 24 of face 7′, the respective faces on expanded portions 7 and 21 being adapted to coöperate in any relative position thereof to form a tight union.

The diaphragm 10 is provided centrally thereof with a suitable opening 11, said opening being provided at the top with an integral ring or flange 12 forming a seat for a check valve 13, as shown in Fig. 4, or a choke valve 14, as shown in Fig. 2. Sets of lugs 15 and 16, respectively, to which the check valve 13 may be pivoted, as at 17, when desired, are provided on the web 10, but it is to be understood that neither the check valve nor the choke valve will necessarily have to be used with my device, which may be used merely for the purpose of forming angle unions, as desired.

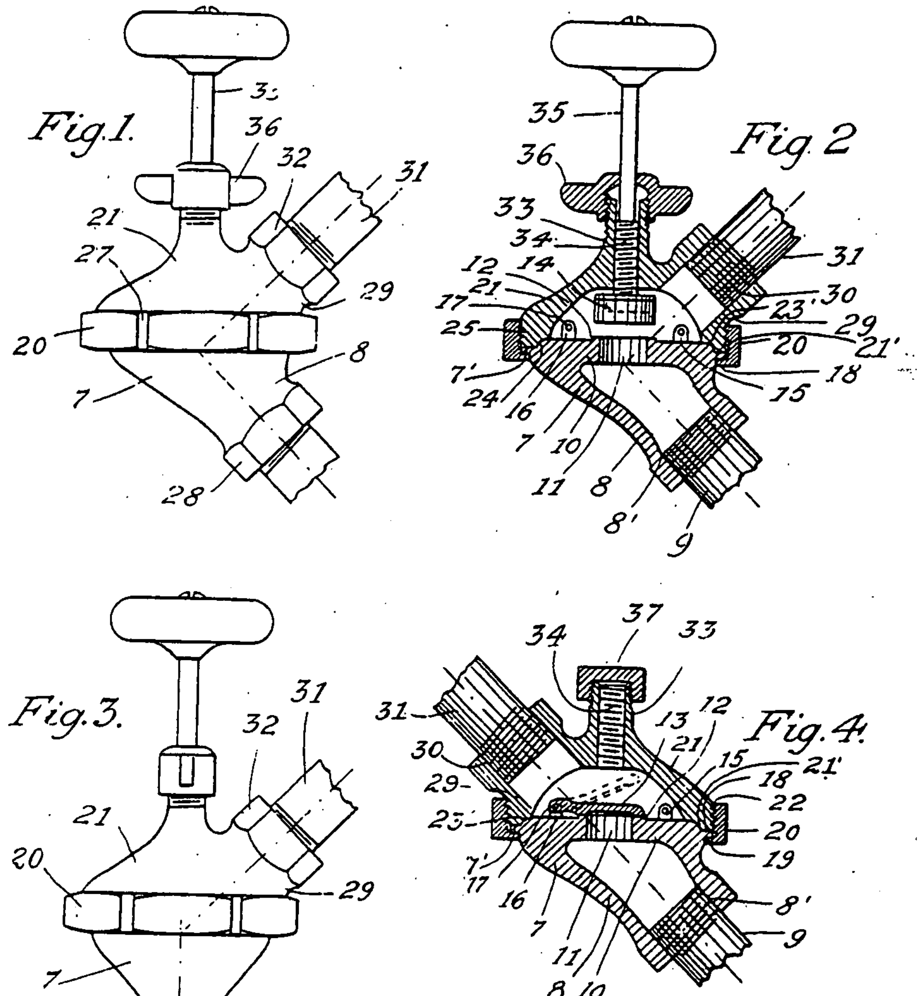
The member 7 is provided with an annular outwardly extending flange 18 in the plane of the web 10 adapted to coöperate with an inwardly extending annular flange 19 on the interiorly threaded coupling ring 20 by means of which an upper member 21 is secured to the base member 7, said upper member being provided with threaded annular surface 22 for that purpose and also with a milled seat 23 adapted to coöperate with a curved portion 24 extending around the top of the web 10 the surface of said curved portion being correspondingly milled so as to enter exactly into and coincide with the surface of the seat 23. If desired, a packing ring may be used between the flange 18 and the coöperating face 25 of the member 21, but if the coöperating members are properly milled a tight union will be effected without the use of any packing material, or at most a little graphite or similar substance. The ring 20 is shown as being provided with faces 26 and notches 27 to adapt the same to the use of plumbing tools of

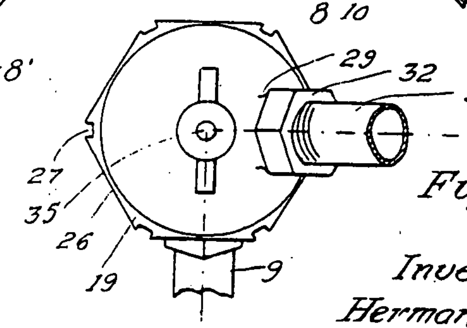
H. G. HAASE.

UNIVERSAL ANGLE COUPLING AND VALVE SEAT FOR PIPING.

APPLICATION FILED FEB. 16, 1911.

1,031,642. Patented July 2, 1912.





Witnesses:
Theo Lagaard.
C. S. Orvold

Inventor:
Herman G. Haase.
By F. A. Whiteley
his Attorney.

ordinary construction. The contracted portion 8 of the base 7 is also hexagonally formed with faces 28 for the same purpose.

Centrally disposed on the member 21 a second diminished extension 33 may be provided having a threaded opening 34 for receiving a correspondingly threaded portion of the valve stem 35 carrying the choke valve 14 in the usual way, said valve being secured upon the extension 33 by means of a hand nut 36. In case it is desired to dispense with the choke valve, either to use the check valve 13 or to use the union without any valve, the valve stem 35 may readily be removed and the opening 34 be closed by a cap 37, as shown in Fig. 4.

The simplicity and practical value of my universal angle union will be apparent. Through its use any form of offset in which the pipes make any desired or necessary angle not less than ninety degrees (90°) can readily be effected. It can be used either with or without the choke valve or the check valve, but it is an especial feature of my invention that it provides a seat for either of said valves capable of use in a straight run of pipe. It is also a feature of my invention that the parts of the valve, both stem and seat, are rendered easily accessible for the purpose of truing the surfaces thereof or remedying other defects.

I claim:

1. A universal pipe fitting comprising two members, each of said members being provided with an expanded portion having an annular face, said faces being adapted to coöperate in any relative position thereof to form a union, a coupling extension formed on each member at an angle of forty-five degrees (45°) with the plane of the face on said member, a diaphragm forming an integral part of one member having its face parallel with the plane of the face of said member and having therein a centrally disposed opening, an integral valve seat surrounding said opening and extended outwardly therefrom toward said other member, means on said diaphragm adapted to pivotally connect a check valve therewith to coöperate with said valve seat, and means to secure said faces in adjustable coöperative relation.

2. A universal pipe fitting comprising two members, each of said members being provided with an expanded portion having an annular face, said faces being adapted to coöperate in any relative position thereof to form a union, a coupling extension formed on each member at an angle to the plane of the face on said member, a diaphragm forming an integral part of one member having its face parallel with the plane of the face of said member and having therein a centrally disposed opening, a valve seat surrounding said opening and extended outwardly therefrom toward said other member, means on said diaphragm adapted to pivotally connect a check valve therewith for coöperation with said valve seat, and means carried by the other member for securing a choke valve in position to coöperate with said valve seat.

3. A universal pipe fitting comprising two members, each of said members being provided with an expanded portion having an annular face, said faces being adapted to coöperate in any relative position thereof to form a union, a coupling extension formed on each member at an angle to the plane of the face on said member, a diaphragm forming an integral part of one member having its face parallel with the plane of the face of said member and having therein a centrally disposed opening, an integral valve seat surrounding said opening and extended outwardly therefrom toward said other member, means on said diaphragm at each side of said opening adapted to pivotally connect a check valve therewith to coöperate with said valve seat when the coupling extensions form either a straight run or a right-angled bend.

In testimony whereof I have affixed my signature in presence of two witnesses.

HERMAN G. HAASE.

Witnesses:

F. A. WHITELEY,

H. A. BOWMAN.

R. M. PIERSON.
VALVE STRUCTURE.
APPLICATION FILED OCT. 29, 1919.

1,399,791. Patented Dec. 13, 1921.

Fig. 1.

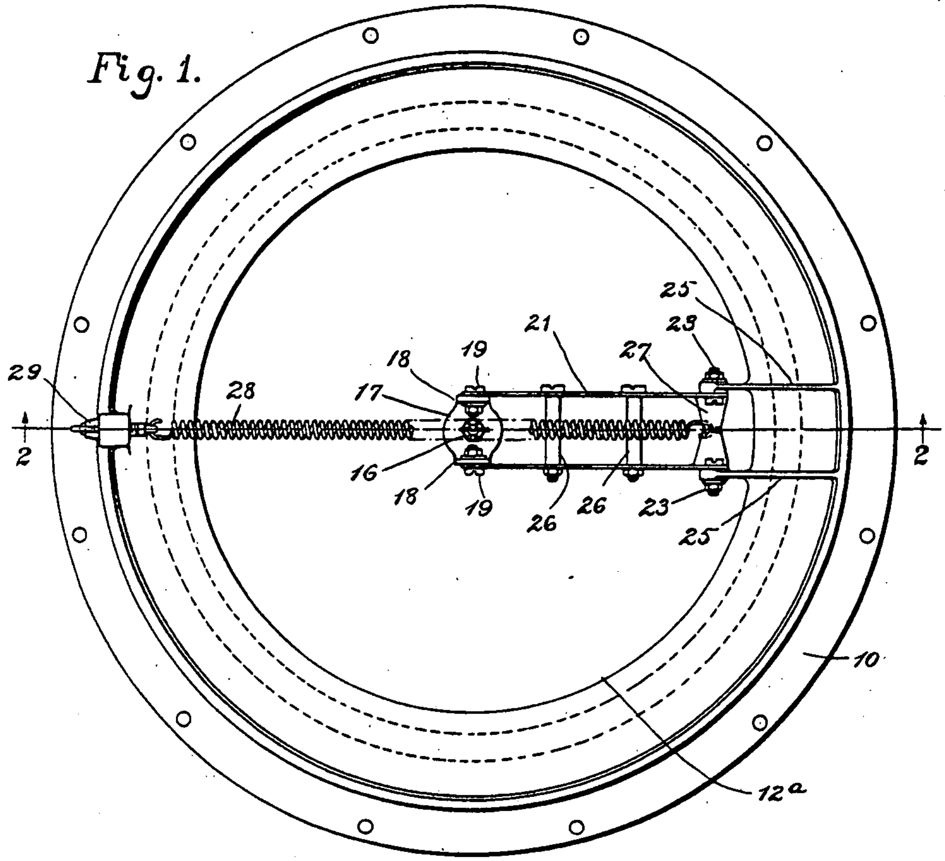
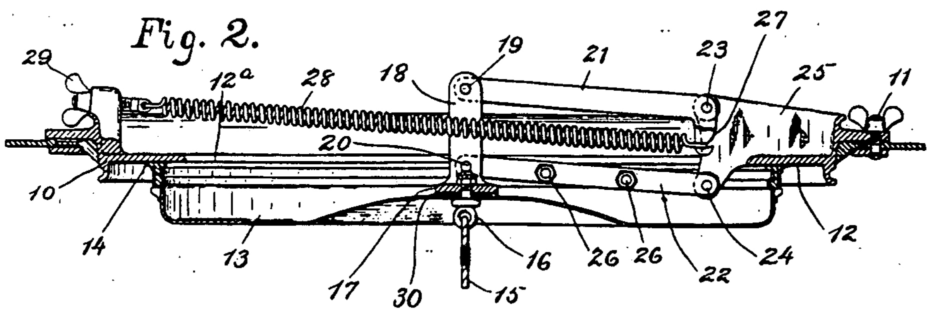


Fig. 2.



Inventor.
Robert M. Pierson.

UNITED STATES PATENT OFFICE.

ROBERT M. PIERSON, OF AKRON, OHIO, ASSIGNOR TO THE B. F. GOODRICH COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

VALVE STRUCTURE.

1,399,791. Specification of Letters Patent. Patented Dec. 13, 1921.

Application filed October 29, 1919. Serial No. 334,332.

To all whom it may concern:

Be it known that I, ROBERT M. PIERSON, a citizen of the United States, residing at Akron, in the county of Summit and State of Ohio, have invented a certain new and useful Valve Structure, of which the following is a specification.

This invention relates to means for mounting and controlling valves, more particularly large valves of the disk type adapted for use on balloons, and its object is to provide means of greater simplicity and compactness than the devices heretofore in use for guiding and supporting the valve proper and yieldingly closing the same against its seat.

Of the accompanying drawings, Figure 1 is a plan view, looking from the outlet side, of a valve structure embodying my invention.

Fig. 2 is a diametric section on the line 2—2 of Fig. 1.

The drawings show, for illustrative purposes, a preferred embodiment of the invention used in connection with an inwardly-opening gas-release valve for balloons of the kite and dirigible types. It will be understood that various uses of the invention are possible and that various changes may be made in the particular form of embodiment.

10 is a metallic frame adapted to be attached to the margins of an opening in the balloon envelop by means of bolts 11 and provided with an annular seat 12, (preferably flat, as shown) surrounding a valve-port 12[a], with which seat the shallow cup-shaped disk valve 13 coacts, there being on the edge of said valve a flexible-lipped soft-rubber packing ring or gasket 14 which permits a certain amount of axial movement of the valve relative to the seat without breaking the sealing contact between the two. 15 is a cord attached to an eye-bolt 16 in the center of the valve and adapted to be actuated by automatic or manual means, or both, for the purpose of opening the valve to permit the escape of gas, this cord in a balloon of either of the types named being usually connected with the air ballonnet so as automatically to pull the valve open when the gas pressure exceeds a certain amount relative to the pressure of the atmosphere.

In these balloon valves, and sometimes in valves for other uses, it is desirable to provide a form of valve supporting and guiding means which shall be simple and compact and as nearly as posible confined in it location to the port or opening controlled by the valve and defined in general by the annular frame structure which includes the valve seat. It is further desirable in many cases that the force of the spring provided for yieldingly holding the valve against its seat shall be so applied and the spring-means so disposed with reference to the other parts that a relatively-small increment of force is developed in the spring at full opening of the valve, as compared with its force when the valve is seated, for in that case the valve when automatically opened by the gas pressure reaching a predetermined amount will tend to a full and wide opening affording a large port area for the quick escape of the gas. These objects are accomplished in the structure here represented. Centrally mounted on the outer face of the valve 13 and conveniently secured thereto by means of the bolt 16 is a stem structure including a plate 17 formed with a pair of upright flat posts or arms 18 to which are pivoted at 19, 20 the inner ends of a pair of guide-links or arms 21, 22 positioned one beyond the other longitudinally, or in the direction of valve movement, the outer ends of these links being pivoted at 23, 24 to a pair of ears or webs 25 which form part of the frame casting 10. The construction of each link includes a pair of flat side bars or plates which, in the lower link 22, are preferably, as shown, connected by cross bars 26 in order to stiffen this link, said bars being omitted in the upper link 21 in order that the latter may straddle the spring and not interfere therewith when the valve is pulled open.

The upper link 21 is provided with a short hooked arm 27 projecting downwardly from the region of the fulcrum pivots 23, and said link with its arm 27 therefor constitutes a ball-crank lever. 28 is a helical pull-spring attached at one end to the hooked arm 27 and at its other end to a point on the frame 10 on the opposite side thereof from the pivots 23, 24, at which point I prefer to locate an adjusting device such as the thumb-nut bolt 29 for varying the tension of said spring at will, this adjusting means being accessible from the outside of the balloon.

The valve 13 may be made to a limited extent self-adjusting with reference to its

seat in order to allow for any slight misalinement of said valve, by attaching the valve disk to its stem member 17, 18 by something in the nature of a universal pivotal connection. Such connection may, for example, consist merely of the bolt 16 and plate 17, together with a soft-rubber washer 30 located between said plate and the valve disk, the washer yielding when necessary to permit the movement of the valve, and serving incidentally to seal the hole in the valve disk through which the bolt 16 passes.

The relative positions of the links 21, 22 and their pivots with reference to the fixed frame 10 and the valve stem 17, 18 are such that during the opening and closing movements of the valve, the latter will be guided in an arcuate path in successive positions of substantial parallelism to itself and to the plane of the valve-seat 12 and port 12^a. They are also such that each link coöperates with the other in controlling the tilting movement of the valve with reference to its seat, such control in this instance amounting to a substantial prevention of tilting, although I do not wholly limit myself to a valve which remains parallel with its seat in all open positions. The spring 28, located crosswise of said port, may be made of considerable relative length without extending beyond the dimensions of the frame 10 in either an axial or a transverse direction. This valve-guiding and spring structure is obviously very simple and compact, especially as compared with prior balloon valves employing a circumferential series of lever, link and spring units. The increment of spring pressure from closed to full-open position of the valve is relatively small and the degree of valve opening is correspondingly large as compared with the magnitude of the valve-opening force. The type and number of springs employed and the point of application thereof may, of course, be somewhat varied without departing from my invention, but I consider it an advantage to use a long, transverse, helical pull-spring substantially as shown, having a fixed anchorage at one end and applied at it other end to a valve-guiding lever which is pivoted on the frame rather than on the valve itself, since in that case the lever end of the spring partakes only of the pivotal movement of the lever and not also of the movement of the valve. This feature of my invention is not limited to use with a valve having an arcuate movement.

I claim:

1. In combination, a valve-seat surrounding a port, a valve, and means for guiding said valve in an arcuate path toward and from its seat in successive positions of substantial parallelism to itself and to the plane of said seat.

2. In combination, a valve-seat surrounding a port, a valve, and a pair of links arranged for guiding said valve in an arcuate path with a parallel movement.

3. In combination, a frame having a valve seat surrounding a port, a valve, a link pivoted to the frame and to the valve for guiding said valve in an arcuate path toward and from its seat, and coöperating means for controlling the tilting of the valve with reference to its seat.

4. In combination, a frame having a valve-seat surrounding a port, a valve, a lever fulcrumed on the frame at one side of said port and having an arm whose inner end connects with the valve in the central region of the latter for guiding said valve in an arcuate path toward and from its seat, coöperating means for controlling the tilting of the valve, and a spring connected with a point on said lever whose range of movement is small compared with that of the valve.

5. In combination, a frame having a valve-seat surrounding a port, a valve movable toward and from said seat, a valve-guiding lever connected to said valve substantially in the middle thereof and pivoted to the frame at one side of said port, and a helical pull-spring attached at one end to said lever and at its other end to the frame on the opposite side of said port.

6. In combination, a frame having a valve-seat surrounding a port, a pair of valve-guiding links pivotally connected at one end to the frame at one side of said port and at the other end to said valve for imposing a parallel arcuate movement upon the valve, and a transverse pull-spring spanning the valve port and connected at one end to one of said links and at its other end to the valve frame.

7. In combination, a frame having a valve-seat surrounding a port, a disk valve movable toward and from said seat and having a stem structure substantially central thereof, a pair of links pivoted to said frame on one side of the port at points longitudinally spaced apart and at their other ends pivoted at similarly-spaced points on the stem structure, the one of said links more remote from the valve having an arm projecting toward the other link, and a helical pull-spring attached at one end to said arm and at its other end to a point on the frame upon the opposite side of said port from the point of support of said links.

In witness whereof I have hereunto set my hand this 23d day of October, 1919.

ROBERT M. PIERSON.

Patented Dec. 2, 1930 1,783,605

UNITED STATES PATENT OFFICE

ERNEST DELLA, OF ROCHESTER, NEW YORK, ASSIGNOR TO WALTER J. McGUIGAN, OF ROCHESTER, NEW YORK

PIPE

Application filed July 13, 1928. Serial No. 292,461.

The present invention relates to pipes and particularly to the type provided with hubs. An object of this invention is to provide a pipe of this type which may be cut so as to eliminate all waste.

To this and other ends, the invention consists of certain parts and combinations of parts, all of which will be hereinafter described, the novel features being pointed out in the appended claims.

In the drawings:

Fig. 1 is a plan view of a pipe constructed in accordance with this invention;

Fig. 2 is a longitudinal section through the pipe; and

Fig. 3 is a sectional view illustrating the manner in which the pipe may be used.

Prior to this invention soil and other pipes have been made in short sections with a hub at one end thereof and when a shorter section has been desired a piece is removed from that end of the pipe opposite the hub and becomes waste because it is not provided with a hub. As pipe sells for a certain amount per foot, this waste in any one year involves even in a small establishment a considerable amount of money.

According to this invention, the pipe is so constructed that it may be cut to a desired length while the remaining portion still has a hub which can be utilized in the same or some other construction work and does not become waste.

In carrying out this invention each end of the pipe has a hub 1 while between the ends one or more pairs of hubs 2 are provided, the latter hubs facing each other and being connected by a weakened portion 3 extending entirely about the pipe. The pipe may also be provided between its hubs with weakened portions 4 in the form of concentric parallel grooves extending entirely about the pipe.

It is apparent that with this construction, a pipe may be cut at the weakened portion between two hubs to obtain a section of the desired length, the other section being provided with a hub which may be used when a section of such length is desired. Two hubs facing each other may be also separated at the weakened portion connecting them.

What I claim as my invention and desire to secure by Letters Patent is:

1. A pipe having between its ends two hub portions facing each other, a weakened portion surrounding the pipe and connecting the facing hub portions.

2. A pipe having hub portions at opposite ends and two hub portions facing each other, and a weakened portion surrounding the pipe between the hub portions.

3. A pipe having hub portions at opposite ends and a plurality of hub portions facing each other, a weakened portion surrounding the pipe between said facing hub portions, and a plurality of parallel spaced weakened portions surrounding the pipe between the facing hub portions and the end hub portions.

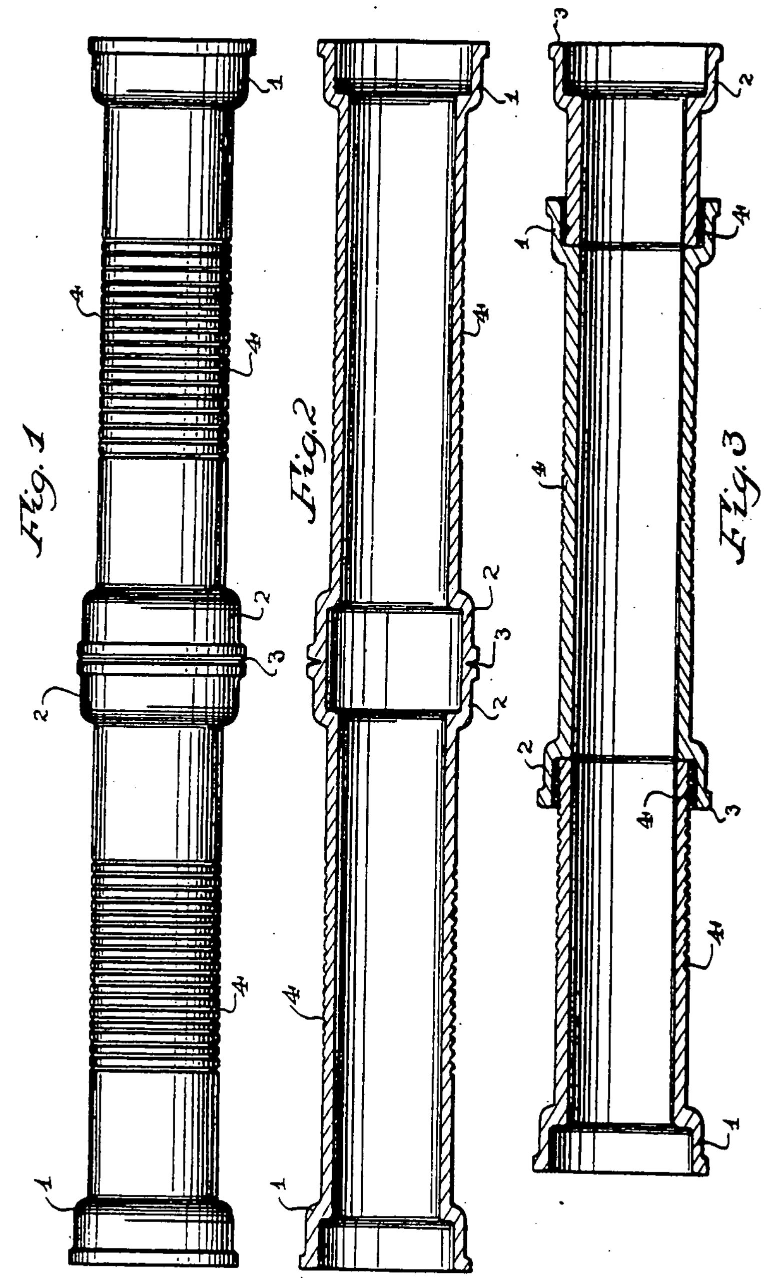
4. A pipe having between its ends a plurality of hub portions arranged close together and facing each other, and a relatively narrow weakened portion surrounding the pipe and connecting said facing hub portions, and a plurality of parallel spaced weakened portions surrounding the pipe between said hub portions and the ends of the pipe.

ERNEST DELLA.

Dec. 2, 1930. E. DELLA 1,783,605

PIPE

Filed July 13. 1928



INVENTOR
Ernest Della
BY [signature]
his ATTORNEY

Patented Aug. 16, 1932 1,871,536

UNITED STATES PATENT OFFICE

FRANK L. LE BUS, OF ELECTRA, TEXAS

WELL DRILLING APPLIANCE

Application filed February 25, 1929. Serial No. 342,444.

This invention appertains to improvements in well drilling appliances generally, and more particularly to a type of the same for facilitating the lowering of a drill pipe string downwardly of a well bore.

In the well drilling practice, it is the common method to drill a well by means of a rotary drill, which is provided with cutting blades, and is carried at the lower end of a string of inter-connected pipe sections. As the pipe string is rotated, and the drill blades are cutting an earth strata, the cuttings are carried out of the well bore by means of a water supply which is forced downwardly of the pipe string from water pumps on the ground surface, the cuttings being carried by the water upwardly of the well bore at the outer side of the pipe string. Hence, during the entire drilling operation, the well bore is full of mud and water.

Since these wells, particularly oil wells, are usually very deep, the pipe string is lowered into and taken out of the well in sections, and this is a necessary procedure in order to keep the drill head supplied with sharp cutters. The drill pipe string is handled by hoisting machinery which is composed, in part, of a crown block, a travelling block, a cable for operating the blocks, and a drum for winding in the cable. The drum is provided with brakes employed as controls, and in handling a long string of pipe as it is being lowered into a well, it is hard on these brakes whenever stops are made in the lowering operation to put on additional sections or lengths of the drill pipe. This is due to the fact that the weight of the string of drill pipe is borne directly on the cable at all times, and until the drill head at the lower end of the pipe string is supported directly on the earth strata at the well bottom.

An object of the invention, therefore, is to provide a means to be incorporated in the pipe string immediately adjacent the lower end thereof, which will tend to float the pipe string in the body of detritus, i. e. water and mud, filling, or nearly filling, as the case may be, the bore of the well, and thereby lightening to an appreciable degree the strain on the cable, and consequently on the drum brakes during the lowering and stopping movements of the drill string.

Another object of the invention is to provide a means of the class set forth, which is in the nature of a valve capable of functioning as aforesaid by closing the bore of the pipe string against the upflow therethrough of the detritus, but which will automatically open to permit of the discharge of a supply of water downwardly of the pipe string bore into the well, under the pressure of the water admitted to the pipe string at the ground surface.

A further object is to so construct the valve aforesaid that the water will pass straight through the pipe string to the cutters on the drill head at the extreme lower end thereof without any appreciable restriction of or retardation in the flow of the water, which construction will have the added advantage that in the case of the necessity to "shoot" the string or pipe below the valve, as when the latter becomes stuck in the well bore, a tube of nitro-glycerin or dynamite will also pass through the pipe string without interference from the valve.

In general, the invention is comprised in a tubular section to be connected directly between the lower end of the pipe string and the drill head usually carried directly thereby, and in the bore of which a valve seat is either formed or mounted. Cooperative with this seat is a valve member, preferably of flat form, which is hinged at one side of the seat, so as to give clear and unrestricted passage therethrough to a water supply or a charge of nitro-glycerin or dynamite passed downwardly of the pipe string from the upper end of the same. The valve is preferably lightly tensioned to closed position on the

Aug. 16, 1932. F. L. LE BUS 1,871,536

WELL DRILLING APPLIANCE

Filed Feb. 25, 1929

Fig. 1.

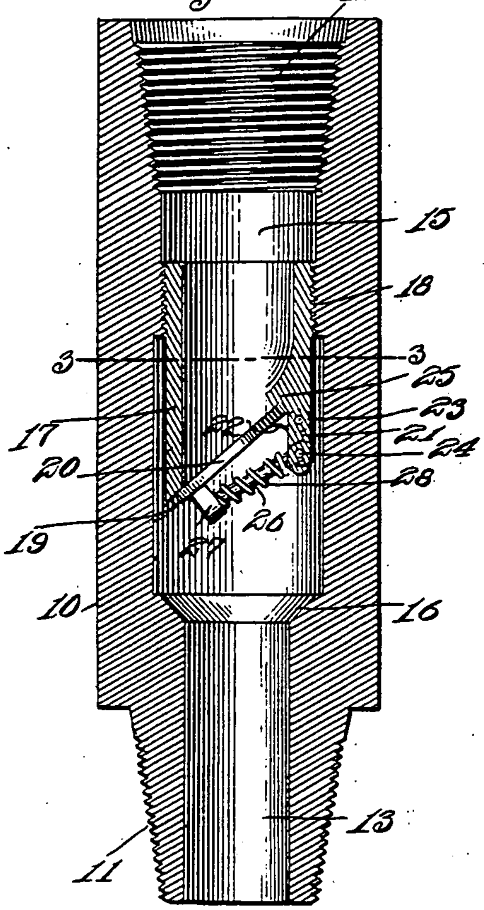


Fig. 2.

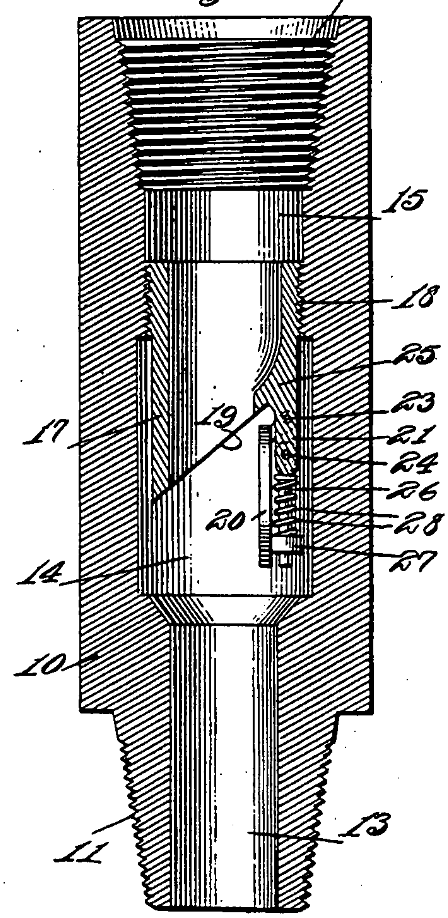
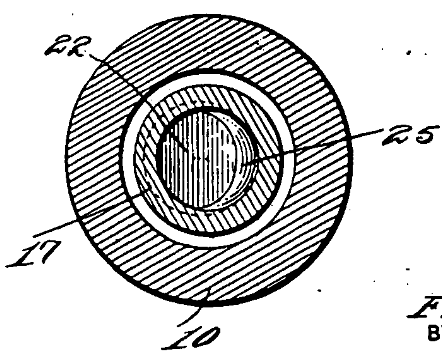


Fig. 3.



WITNESSES

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valve seat at all times, excepting when water or a tube of nitro-glycerin or dynamite is being passed downwardly of the pipe string when it will readily open, under the pressure thereof at its upper side.

With the foregoing and other equally important objects and advantages in view, the invention resides in the certain new and useful combination, construction and arrangement of parts as will be hereinafter more fully described, set forth in the appended claim and illustrated in the accompanying drawing, in which:

Figure 1 is a vertical longitudinal section through a drill pipe section, showing a practical embodiment of the valve and valve seat as preferably incorporated therein, the valve member being shown as it appears when closed,

Figure 2 is a view similar to that in Figure 1, but showing the valve member as it appears in its open position, and,

Figure 3 is a horizontal section taken on the line 3—3 of Figure 1.

Referring to the drawing, wherein like characters of reference designate corresponding parts in the several views thereof, the embodiment of the invention, as shown therein by way of example only, is constituted in a tubular body or pipe section 10 of an equal exterior diameter to that of the connection end of a drill head (not shown), and a drill pipe section (not shown) between which it is to be interposed in connected relation therewith, the lower end of the body or pipe section being provided with a usual form of reduced and tapered screw threaded portion 11, and its upper end with an inwardly tapered screw threaded socket portion 12.

Opening concentrically upward of the lower end of the body 10 is a bore 13, which is of an equal diameter to that of the vertical bores in the drill head and the pipe sections aforesaid, and which communicates at its inner or upper end with an intermediate bore 14 of a greater diameter. The upper end of this intermediate bore 14 connects with a shorter bore portion 15, which is of a slightly less diameter than the same, but still of a greater diameter than the lower bore 13. This bore portion 15, in turn, opens into the lower end of the tapered socket 12.

Positioned within the body 10 is a shorter tubular body 17, which is exteriorly screw threaded at its upper end for engagement, as at 18, with a screw thread formed in the lower half of the wall of the bore portion 15. By this arrangement, the lower end portion of the tubular body 17 depends into the intermediate bore portion 14 in spaced relation with respect to the wall thereof, and with its extreme lower end spaced at a distance from the point of mergence of the lower end of the bore portion 14 into the bore portion 13. The lower end of the bore portion 14 is preferably connected with the adjacent end of the lower bore 13 by means of an annular sloping wall portion 16, substantially as shown.

The lower end of the tubular valve body 17 is cut away to provide an angular or inclined seating surface 19, against which a valve member or flap 20 will seat when closed. Depending from the shorter side of the valve body 17 is an extension or lug 21, which is bifurcated vertically and inwardly of its lower end to receive in the space between the opposite leg portions thereof an ear or lug 22, angularly offset from the under side of the adjacent edge portion of the flap or valve member 20. This ear or lug 22 is suitably apertured for the engagement of the upper of a pair of pivot pins 23 and 24 therewith, which pins are mounted transversely of and in the bifurcated portions of the extension or lug 21. The wall of the valve seat 17 is inwardly thickened, as at 25, immediately above the adjacent underlying portion of the valve member 20, so that when the latter swings downwardly to full open position, it is protected by the overhang of this thickened portion or shoulder from undue wear thereon by the force of the flow of water downwardly of the pipe string in which it is incorporated. The upper side of the thickened portion of the shoulder 25 is preferably curved downwardly and inwardly from its point of mergence into the vertical wall of the upper portion of the valve seat, so that it will offer no impediment to the free downward flow of the water.

Engaged on the lower pivot pin 24, at one end is an elongated member or rod 26, which underlies the valve member 20, and has its other end engaged for free sliding movement in an aperture formed in a projection or lug 27, depending from the underside of the valve member. A coiled spring 28 is encircled about the intermediate portion of the rod 26, and is tensioned thereon between the extension 21 and the lug 27, whereby the valve member or flap 20 will be retained in open position as shown in Fig. 2 since it swings to full open position under the pressure of a downflow of water through the tubular body 17, or under the force exerted thereon by a charge of dynamite or nitro-glycerin lowered in the pipe string. On the other hand a back flow of water or other liquid will release the valve from the position shown in Fig. 2 so that the spring 28 will come into play and force the valve towards closing position. The back flow of the water at this time will cause a positive seating of the valve.

In the use of the device, when coupled in on a drill pipe string immediately above the drill head at the lower end of the latter, the valve member or flap 20 will be normally maintained in closed position on its seat 19 by the action of the spring 28. Now, as the

pipe string is lowered into a well bore, and the drill head enters the mud and water content of the well, air will be pocketed within the pipe string below the valve 20. Thus, the mud and water will be prevented from entering the pipe string above the valve member or flap 20, and the air trap below the same will act to impart a partial buoyancy to the pipe string and to an extent to greatly facilitate the lowering movements thereof with a minimum amount of wear and tear on the winding drum brakes, as well as on the operating machinery as a whole.

As soon as the pipe string has been lowered to the bottom of the well and the drilling operation is continued, water will be introduced into the upper end of the pipe string from the usual water pumps, and the pressure of the same will cause the valve 20 to open when the water will pass to the drill cutters and outwardly into the bore of the well, where it mixes with the bore cuttings in the usual manner to reduce the same to a liquefied state, commonly called "detritus," and thereby facilitating the removing of the cuttings from the well bore. This detritus is subsequently discharged upwardly of the well bore at the outer side of the drill pipe string, so that in the use of the valve 20 in the latter, the interior of the string, at least above the valve, is kept free of the detritus at all times.

In the event of it becoming necessary at any time to shoot the string of pipe below the valve 20 to recover it when it becomes stuck, a tube of nitro-glycerin or dynamite may be readily passed downwardly of the pipe string and through the valve body 17 without interference therewith of the valve member or flap 20, which will swing to open position beneath the thickened portion of shoulder 25, and entirely clear of the passage through the valve body 17. Immediately upon being relieved of the pressure of water, or after the passage of a tube of nitro-glycerin or dynamite through the valve body, the valve member or flap 20 will be swung to closed position by the expansive action of the spring 28.

Without further description, it is thought that the features and advantages of the invention will be readily apparent to those skilled in the art, and it will of course be understood that changes in the form, proportion and minor details of construction may be resorted to, without departing from the spirit of the invention or its scope as claimed.

Having thus fully described the invention, what is claimed is:

In a device of the class described, a tubular body adapted to be coupled in on a string of drill pipe sections adjacent the lower end thereof, a sleeve threaded into the tubular body member and provided with a valve seat inclined at an angle to the horizontal, an arm projecting downwardly from the upper end of the valve seat, a valve pivotally mounted on the arm and adapted to engage the seat, a rod pivotally mounted on the arm adjacent the valve, an ear secured to the valve and provided with a passage adapted to receive the free end of the rod and a spring located between the ear and the arm, the sleeve, valve, and valve mounting being removable as a unit from the upper end of the tubular body.

FRANK L. LE BUS.

Patented Oct. 30, 1934

UNITED STATES PATENT OFFICE

1,978,507

MULTIPLE CHECK VALVE

Henry J. Rand, Kansas City, Kans.

Application March 20, 1933, Serial No. 661,744

7 Claims. (Cl. 4—211)

This invention relates to plumbing systems for buildings wherein is incorporated an air intake vent, and the primary object of the invention is to provide a check valve that will permit taking air from exteriorly of the building, whereby to supply the system when vacuums or suctions are created therein for periodically using the plumbing system for the removal of waste from within the building.

One of the important aims of the instant invention is the contemplation of a multiple check valve usable as aforementioned and constructed to permit the introduction of air from within the building to the plumbing system, and yet to preclude the escape of objectionable, obnoxious gases from the plumbing system into the building.

Another object of this invention is to provide a combination of parts within a plumbing system that will allow the effective use of the check valve forming the major part of this invention with specially formed building walls and plumbing fixtures, all of which are assembled in a manner to allow disposing an intake air vent within the building to overcome hereinafter mentioned objections with respect to exterior vents.

A yet further object of the invention is the provision of a valve of the character mentioned, wherein is formed a plurality of chambers, said chambers being of different size of capacity and divided from each other by movable valve heads, normally held closed by the action of gravity, which heads will require forces of different intensities to withdraw them from their closed position.

Under ordinary conditions, and as a result of established practice, vents for plumbing systems are located outside of the building. During certain season of the year the projected end of a vent pipe will very often become completely clogged with frost so that when the plumbing system is evacuated by the passage of a volume of waste therethrough, the vent pipe will be unable to allow the introduction of sufficient volume of air to replace that drawn from the system when the waste material flows therefrom through the main sewer pipe of the building.

It, therefore, becomes desirable to provide within the building, a vent which will be protected against such clogging and which will take air into the system from within the building. This desirability is qualified by the objection that with check valves heretofore employed, obnoxious gases have escaped from the plumbing system into the building and likewise, germs find their way from the system into the building, both of which must positively be thoroughly overcome before a plumbing system having an interior vent and check valve rises to a point where it will be approved by health authorities or will be satisfactory to the building occupant.

The aforementioned broad objects of this invention and the minor objects thereof which will appear during the course of the following specification, when fulfilled by suitable structure, will be capable of teaching the construction and installation of a multiple check valve that will overcome the objections to interior vents, as just set forth.

The preferred form of this invention is illustrated in the accompanying drawing, wherein:

Figure 1 is a sectional view through a catch basin and a portion of a hollow building wall, illustrating a fragment of a plumbing system and the vent thereof that is equipped with a valve embodying this invention.

Fig. 2 is an enlarged, fragmentary, longitudinal, central section through the valve.

Fig. 3 is a cross section taken on line III—III of Fig. 2.

Fig. 4 is an end elevation of the valve.

Fig. 5 is an enlarged, fragmentary, sectional view showing the valve in position.

Fig. 6 is an end elevation of the valve illustrated in Fig. 5, and,

Fig. 7 is a longitudinal, central section through the multiple section valve illustrating the angular relation between apertured partitions therein.

Fig. 1 illustrates one manner of bringing together parts of a plumbing system so that the valve contemplated might be positioned within a hollow wall 10 having an opening 12 formed through one side thereof which communicates with the space 14 formed behind a splash apron 16 that forms a part of catch basin 18 that, in turn, is connected with a part of the plumbing system 20 by branch 22. Vent pipe 24 extends upwardly within the space formed by wall 10 to a point adjacent opening 12 where the multiple check valve 26 is secured in place. When so positioned, this check valve will draw air from within the building along a path indicated by the arrows in Fig. 1, and the aforementioned objects will thereby be fully met.

Fig. 5 illustrates another manner in which this check valve might be incorporated in a plumbing system. In this instance wall 28 supports check valve 26 and member 30 creates a finished appearance at the point where valve 26 passes through wall 28 and joins a part of the plumbing system by way of vent pipe 24.

With respect to the specific structure of valve 26 per se, it is important that the same be made up of a plurality of sections 32, each cylindrical and divided by a transverse partition 34 which intersects the longitudinal axis of the section 32 at an angle, as illustrates in Figs. 2 and 7. Sections 32 are in screw-threaded relation as shown at 36, and one of these sections 38 is modified so that it will support perforated screen 40, having radially extending slots 42, whereby diametrical contraction might take place when screen 40 is pressed to position within the confines of annular shoulder 44, formed by section 38.

As illustrated in Figs. 6 and 7, screen 40 has an inturned, annular flange 46 for the purpose of securely gripping shoulder 44. Each partition 34 has an aperture 48 formed therethrough that is covered, when the valve is closed, by a swingable valve head 50 that rests upon partition 34 which serves as a seat for head 50. The manner in which valve head 50 is swingably mounted within its section 32 of case 26 is clearly shown in Figs. 2, 3 and 7, and the mounting might be effected through the use of opposed bosses 52 formed integrally with the body of section 32, through which is passed a pivot pin 54 that swingably supports link 56 between bosses 52. The free end of link 56 engages projection 58 formed on head 50 and nut 60 precludes displacement of these parts.

As shown in Fig. 2, line 56 has an opening 62 therethrough to receive member 58 that is substantially larger in diameter than the member itself, and nut 60 does not move tightly against link 56, all for the purpose of creating a looseness of fit so that seating of valve head 50 might be effective and not retarded by binding parts.

Manifestly, these valve heads 50 are maintained in the closed or seated position by the action of gravity, and to positively seal the valve against the escape of gases from the plumbing system or the escape of germs therefrom into the building, there is provided a plurality of valve structures as just described, all of which must be opened before fresh air is drawn into the plumbing system.

Each of the plurality of partitions and valve heads 34 and 50 respectively is disposed at an angle different from that of the other similar parts of the valve and the angularity of the valve head and partition closest to the point of connection with vent pipe 24 should be greater in order that more force is required to draw the same to the open position. When this is accomplished, the air from within chamber 64 will evacuate into the plumbing system in an effort to overcome the vacuum that has been created therein by the passage therethrough of a quantity of waste. Obviously, the vacuum or suction set up will be sufficient to draw the next succeeding valve open and evacuate chamber 66 and again this same action will be repeated so that the last valve will be opened and air at atmospheric pressure will be drawn into the system by passing through all of the apertured partitions 34. Obviously, as the angle is decreased from true vertical it will be easier for the valve heads 50 to be drawn open and this angle approaches the vertical as the screened end of valve 26 is approached.

When sufficient air has been drawn into the system to overcome the vacuum therein, gravity will draw heads 50 closed and a multiple seal will be established to fulfill the primary requirement of such a valve and to meet the broader concepts of this invention.

This valve and its parts might be constructed of metal or other suitable substance and the connection between sections of the case might be effected through other mediums than those illustrated. The relation between the angled valves, the size of the chamber formed therebetween, and the suction created within the plumbing system is of great importance and a valve made to embody the features of this invention will fulfill the duty of establishing proper combination in order that a perfect seal against escaping of objectionable gases and other contamination will always be established when sufficient suction within vent pipe 24 is not present to hold all of the plurality of heads 50 in an open position.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. In a plumbing system having an interior air intake vent, a multiple check valve allowing air to enter the system and to preclude the escape of gases from the system comprising a case; a plurality of spaced-apart valve seats formed in series within the case; and a swingable valve head for each seat respectively, said heads being maintained against their seats by the action of gravity.

2. In a plumbing system having an interior air intake vent, a multiple check valve allowing air to enter the system and to preclude the escape of gases from the system comprising a case; a plurality of spaced-apart valve seats formed within the case; and a swingable valve head for each seat respectively, said valve seats being disposed at different angles and the heads being maintained against their respective seats by the action of gravity, all the heads and associated parts swingable therewith being substantially the same weight whereby the force required to lift one of said valve heads is different than that required to lift any of the others.

3. In a plumbing system having an interior air intake vent, a multiple check valve allowing air to enter the system and to preclude the escape of gases from the system comprising a case; a plurality of spaced-apart valve seats formed within the case; and a swingable valve head for each seat respectively, said valve seats and valve heads being disposed at different angles to form chambers of different capacities within the valve case.

4. In a plumbing system having an interior air intake vent, a multiple check valve allowing air to enter the system and to preclude the escape of gases from the system comprising a case; a plurality of spaced-apart valve seats formed within the case; and a swingable valve head for each seat respectively, said case comprising a plurality of sections in screw-threaded engagement each having a valve seat and a valve head therein, the said seats and heads of the valve being at different angles with the heads maintained in closed position by the action of gravity.

5. In a plumbing system for buildings, an interior intake vent, and a catch basin connected for drainage by said system and having a splash apron spaced from the wall of the building, a multiple check valve allowing air to enter the system and to preclude the escape of gases from the system, positioned to draw air from within the building at a point behind the said splash apron.

6. In a plumbing system for buildings, an interior intake vent and a catch basin connected for drainage by said system and having a splash apron spaced from the hollow wall of the build-

ing wherein is formed an opening interconnecting the space within the hollow wall and the space behind said splash apron, a check valve allowing air to enter the system and to preclude the escape of gases from the system, positioned within the hollow wall at a point adjacent the opening formed in the said wall whereby to draw air from the interior of the building by way of said opening and space behind the said splash apron.

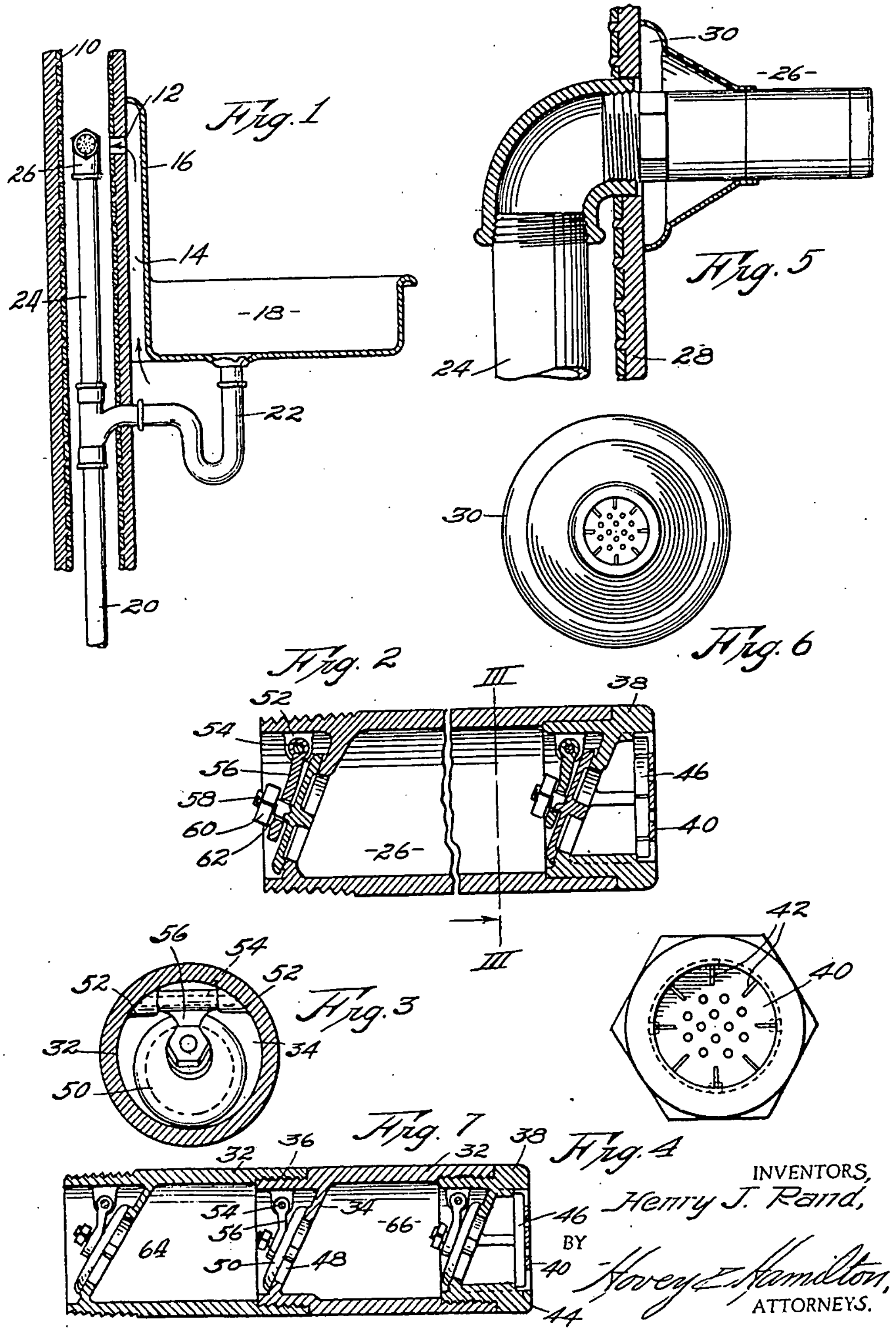
7. A valve of the character described comprising a case having a plurality of longitudinally aligned hollow, cylindrical sections; a transverse partition within each of said sections having an aperture formed therethrough; and a swingably mounted valve head within each section movable to and from a position to close the aperture through the associated partition, said partitions intersecting the longitudinal axis of the case at an angle thereto and the valve heads being held against the partitions by the action of gravity, the partitions and valve heads being spaced apart and disposed at different angles to the longitudinal axis of the case whereby to form a plurality of chambers of different size therein.

HENRY J. RAND.

Oct. 30, 1934. H. J. RAND 1,978,507

MULTIPLE CHECK VALVE

Filed March 20, 1933



Patented Dec. 15, 1936

2,064,247

UNITED STATES PATENT OFFICE

2,064,247

KICK-OFF COLLAR

Seth Evans, Houston, Tex., assignor to Hughes Tool Company, Houston, Tex., a corporation of Texas

Application April 24, 1934, Serial No. 722,070

9 Claims. (Cl. 103—232)

My invention relates to automatically operating valves employed in controlling the passage of pressure fluid to or from a well tube in air or gas lift devices where said valves are used with or without a plunger in said tube. Such valves are commonly called kick-off valves for the reason that they allow the air or gas to enter below the load of liquid above the valve and force said load from the well.

It is an object of my invention to provide a kick-off valve which will be held resiliently in either open or closed position.

I desire to provide a valve that, when closed, will be held in that position by pressure in addition to that of the pressure fluid so that leakage about the valve may be prevented. Where a valve is held normally open and is closed only by a sufficient differential of pressure between the inside and outside of the eduction tube, the valve tends to be held very loosely in closed position particularly where the pressures are light or variable, and leakage past the valve may occur. This, I aim to avoid.

I also aim to provide a valve which, when closed, will not open again when the fluid pressures are equalized on both sides of the valve, but which will require a reversal of pressures to move the said valve from closed position.

In the drawing herewith Fig. 1 is a central vertical section through a kick-off valve embodying my invention.

Fig. 2 is a side elevation of the valve shown in Fig. 1.

Fig. 3 is a central vertical section similar to Fig. 1 but illustrating a slightly different embodiment of the invention.

Fig. 4 is a transverse section through the valve shown in Fig. 3 and taken on the plane 4—4 in that figure.

My valve is preferably incorporated in a tubular collar 1, threaded at its ends to be coupled in the eduction tube 2 for conducting the liquid from the well. On one or more sides of the collar I provide an inlet port 3 in which is fixed a seat ring 4 having a flared opening therethrough to receive the valve 5.

The valve seat is formed in a groove 6 provided in the thickened portion 7 of the wall of the collar. This groove serves also to house and protect the valve 5 and its control mechanism. Said valve is shown of hemispherical shape with a projecting stud 8 on its outer face, said stud extending through an opening in the end of the arm 9, and having its extremity upset to hold said valve loosely in position on said arm.

The arm 9 has its end remote from the valve beveled to an edge 10, and as will be seen from Fig. 2, the arm is a flat plate. The beveled end engages within transverse notches in a pair of arms 11, extending upwardly from a base 12 secured to the inner wall of groove 6 by a cap screw 13. Between the two arms 11 is mounted a tension spring 14, the upper end of which is engaged through an opening 15 in the arm 9. The lower end is anchored to a plate 16, held in place by said cap screw 13. This spring holds the arm 9 with its lower end fitting within the grooves 10 but allowing it to rock between the valve seat and an outer stop plate 17.

The stop plate comprises a narrow plate of metal having its upper end fixed to the collar within the groove 6 by a cap screw 18 or other similar means. The plate is bent outwardly and has a stop finger 19 at its lower end to limit the outward movement of the valve arm 9.

In use the spring 14 acts to hold the valve arm in either open or closed positions of the valve, with a certain resilient force which may be overcome to move the valve by a predetermined preponderance of fluid pressure on one side or the other of the valve. The pressure differential necessary to move the valve may be varied by the size or tension force of the spring 14. It is obvious that when the valve has been closed, it will be held in that position until a preponderance of pressure within the tube moves the valve to its open position shown in dotted lines in Fig. 1.

In the embodiment shown in Fig. 3 the structure is the same as is that in the Fig. 1 embodiment except for the mounting of the valve and its control mechanism. In this form the valve 5 is mounted upon the lower end of an arm 9ᵃ. This arm is beveled at both ends to a knife edge 10ᵃ and 10ᵇ so as to allow a rocking movement at either end. The upper end of the arm fits within an annular groove 20 in a screw head 21. The lower end of the arm engages in a groove 22 in a rock arm 23.

The lower end of the rock arm 23 fits slidably within a socket 24 in a rocking member 25, the lower beveled end of which fits within a groove in the head 26 of a cap screw 27. Between the socket 24 and a head 28 upon the arm 23 is a tension spring 29 which holds said head with a certain force into engagement with the edge 10ᵇ of the valve arm 9ᵃ.

Dec. 15, 1936. S. EVANS 2,064,247

KICK-OFF COLLAR

Filed April 24, 1934

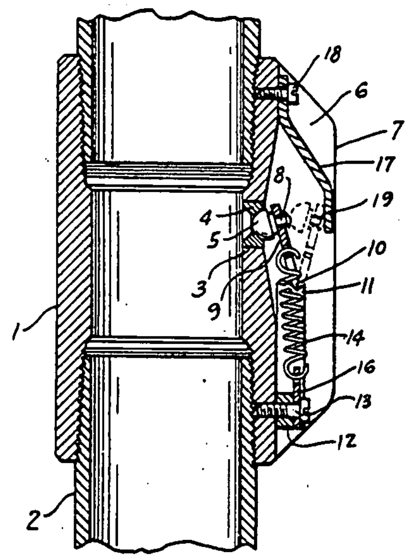


Fig. 1

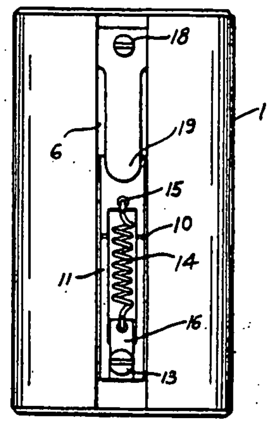


Fig. 2

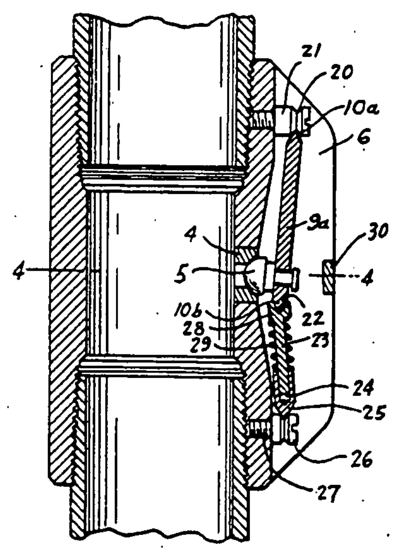


Fig. 3

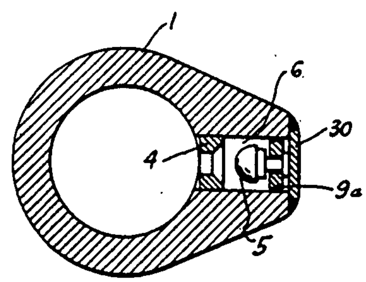


Fig. 4

Seth Evans
INVENTOR.

BY Jesse R. Stone
ATTORNEYS.

To limit the outward swing of the valve in this embodiment, I employ a cross bar or plate 30 extending across the groove 6 and secured in place by welding or other preferred means.

In both embodiments, a toggle mechanism is employed to hold the valve in either open or closed adjusted position, but allowing the movement of the valve at the desired time. The advantage of this means of controlling the valve is that, when once moved to either position the valve may be depended upon to stay positively in the proper position until the direction of flow through the valve orifice changes with sufficient force to move the valve. Thus when the valve is closed the operator may rely upon its staying closed and not leaking so long as there is not a marked reversal of pressure, whereby the fluid pressure inside the tube moves the valve to open position. If when the device has all the valves closed and it is desired to open them, this may be readily accomplished by the introduction of sufficient pressure fluid into the tube 2.

Thus also when the valve is employed with pneumatically operated plungers within the tube, the valves would tend to open at each rise of the plunger due to equalization of pressures at the valve, but where my valve is employed the valve will not open until there is an excess of pressure within the tube. I thus have a valve which may be depended upon to remain in open or closed position, but which may be controlled by the exertion of a predetermined excess of pressure upon either side of the valve.

What I claim as new is:

1. A tubing coupling having a lateral fluid port therein, a valve seat in said port, a valve adapted to fit said seat, and means controlling said valve and acting to hold said valve in either open or closed position with a predetermined force, said valve being adapted to be moved by a preponderance of fluid pressure on one side thereof.

2. A tubing coupling having a lateral fluid port therein, a valve seat in said port, a valve adapted to fit said seat, a swinging valve arm supporting said valve, a second arm having a rocking engagement with one of the ends of said valve-arm, and a spring acting to hold said two arms in engagement.

3. A tubing coupling having a lateral fluid port therein, a valve seat in said port, a valve adapted to fit said seat, a pair of arms having a rocking engagement with each other, one of said arms acting to support said valve, means to limit the movement of said valve away from said seat, and means giving a toggle action to said arms to hold said valve in either open or closed position.

4. A tubing having a lateral port therein, a valve seat on the outer end of said port, a valve arm outside said port, a support for one end of said arm allowing said arm to swing, a valve on the swinging end of said arm, and a spring acting to hold said arm in swinging engagement with said support, and to retain said valve resiliently in either open or closed position relative to said seat.

5. A tubing having a lateral port therein, a valve seat on the outer end of said port, a valve arm outside said port, a support for one end of said arm allowing said arm to swing, a valve on the swinging end of said arm, means to limit the movement of said valve away from said seat, and a spring acting to hold said arm in swinging engagement with said support, and to retain said valve resiliently in either open or closed position relative to said seat.

6. A flow device for wells including a well casing, a tube therein, a collar on said tube, a fluid passage to conduct pressure fluid in said casing through the wall of said collar, said passage having a valve seat therein, a valve tending to control said passage and positioned to be moved by pressure fluid to and from position closing said passage and means to hold said valve in either open or closed position with a predetermined force.

7. A flow device for wells including a well casing, a tube therein, a collar on said tube, a fluid passage to conduct pressure fluid in said casing through the wall of said collar, said passage having a valve seat therein, a valve tending to control said passage and positioned to be moved by pressure fluid to and from position closing said passage, and means acting to hold said valve resiliently in either open or closed position relative to said seat.

8. A flow device for wells including a casing, a flow tube therein, a collar on said tube, a fluid passage through the wall of said collar having a seat therein, a valve mounted to engage said seat and positioned to be moved by fluid pressure to and from closed position, means to limit the movement of said valve away from said seat so that the flow of fluid into said port with a predetermined rate of flow will seat said valve, and means holding said valve resiliently in either open or closed position.

9. A tubing for wells, a coupling thereon having a lateral fluid port therein to permit pressure fluid to flow from said well into said tubing, a valve positioned adjacent said port and adapted to be closed by the flow of pressure fluid through said port, and means to hold said valve resiliently in closed position, said valve being moved to open position by a preponderance of fluid pressure on the inside of said tube, said means then acting to retain the valve resiliently in open position.

SETH EVANS.

Patented Dec. 10, 1940

2,224,290

UNITED STATES PATENT OFFICE

2,224,290

AUTOMATIC VALVE LOCKING AND RELEASING DEVICE

Elbert A. Corbin, Jr., Lansdowne, Pa., assignor of one-half to William C. Biddle, Lansdowne, Pa.

Application December 27, 1938, Serial No. 247,834

3 Claims. (Cl. 277—33)

My invention relates to a new and useful automatic valve locking and releasing device particularly adapted for use in connection with two or more interdependent valves, that is, valves which must be opened or closed only on a predetermined order with respect to other valves, whereby certain valves are locked against operation until the proper time has arrived and are then automatically released for operation by the movement or actuation of other valves whereby the preordained order in which all of the valves are to be opened or closed is positively adhered to, not by virtue of the attention or carefulness of the operator, but by virtue of the fact that even a careless or inattentive operator cannot possibly make a mistake since the parts cannot even be moved except in the proper order.

The number of instances in industry in which interdependent valves must be operated in a given, predetermined order are too many to enumerate and hence only one or two particular examples will be referred to. Thus, in the blowing of boilers, for instance, it is necessary, both as a matter of practice and because it is prescribed in the code, that the inboard valve be completely open before the outboard valve is at all moved if all damage to the inboard valve is to be avoided. According to present constructions the operator, through carelessness, inattention, or lack of appreciation of the possible damage, is as likely as not to open the outboard valve partly or fully before opening the inboard valve, or he may fail to open the inboard valve completely before beginning to open the outboard valve thus causing expensive damage. An attempt has been made heretofore to avoid this serious disadvantage and, as far as I am aware, this attempt consisted in enclosing the valve to be opened last in a bag which is locked and the key to which is placed in the office or with the foreman who will only give it to the operator after making sure that the valve to be opened first has been completely opened. The disadvantage of such a practice is obvious.

Another instance may be observed in the piping and valving of the oil industry in which, whether it be for diverting different grades of oil or for interrupting the flow at desired points or for mixing the flow from various predetermined pipes into one common outlet in a given order, it is again necessary to insure the complete opening or complete closing of one or more interdependent valves simultaneously, successively or alternately, and, so far as I am aware, this has heretofore been left entirely to the attention of the operator in charge, and heretofore numerous and costly mistakes have been inevitable and considerable time and labor has been expended constantly in checking the various valves to insure proper operation.

The foregoing instances merely illustrate the scope of the problem which I have solved by my novel construction which will be more clearly understood from the following specification and the accompanying drawing in which:

Fig. 1 represents a view in vertical section showing a pair of valves interlocked by the device embodying my invention.

Fig. 2 represents diagrammatically and on an enlarged scale a fragmentary top plan view of the left hand portion of the right hand valve wheel and the latch cooperating therewith, the latter being shown detached from the left hand valve of Fig. 1.

Fig. 3 represents on an enlarged scale a section on line 3—3 of Fig. 1.

Referring to the drawing in which like reference characters indicate like parts and more particularly to Fig. 1, 12 designates a valve body having the inlet 14 and the outlet 16 which communicate with the valve chamber 18. In the valve chamber 18 is disposed a valve piston 20 which is raised and lowered by rotation of the hand wheel 22. The outlet 16 of the valve body 12 registers with the inlet 24 of the valve body 26 which is provided with the outlet 28, the valve bodies 12 and 26 being suitably secured together as by the bolts 30. In the valve chamber 32 of the valve body 26 reciprocates the piston 34 which is operated by the rotation of the hand wheel 36. As far as the purposes of this invention are concerned it is deemed unnecessary to describe the exact details of the mounting or structure of the pistons 20 and 34. In order to prevent the movement of the piston 34 except according to the preordained order which, as shown in Fig. 1, must occur after the actuation of the piston 20, I have provided the hand wheel 36 with a groove 38 which is provided with suitably spaced locking recesses 40 and I have provided a latch 42 which passes through the valve body 12 and which is provided with the cam face 44. The latch 42 is normally pressed inwardly into the valve chamber 18 by the spring 46 so as to project inwardly into the valve chamber as seen in Fig. 1. The outer end of the latch 42 is deflected to form the elbow 50 which is adapted to engage one of the locking recesses 40. With the parts as shown in Fig. 1, that is, with the valve piston 20 in its closing position, the elbow

Dec. 10, 1940. E. A. CORBIN, JR 2,224,290

AUTOMATIC VALVE LOCKING AND RELEASING DEVICE

Filed Dec. 27, 1938

Fig. 1.

Fig. 2.

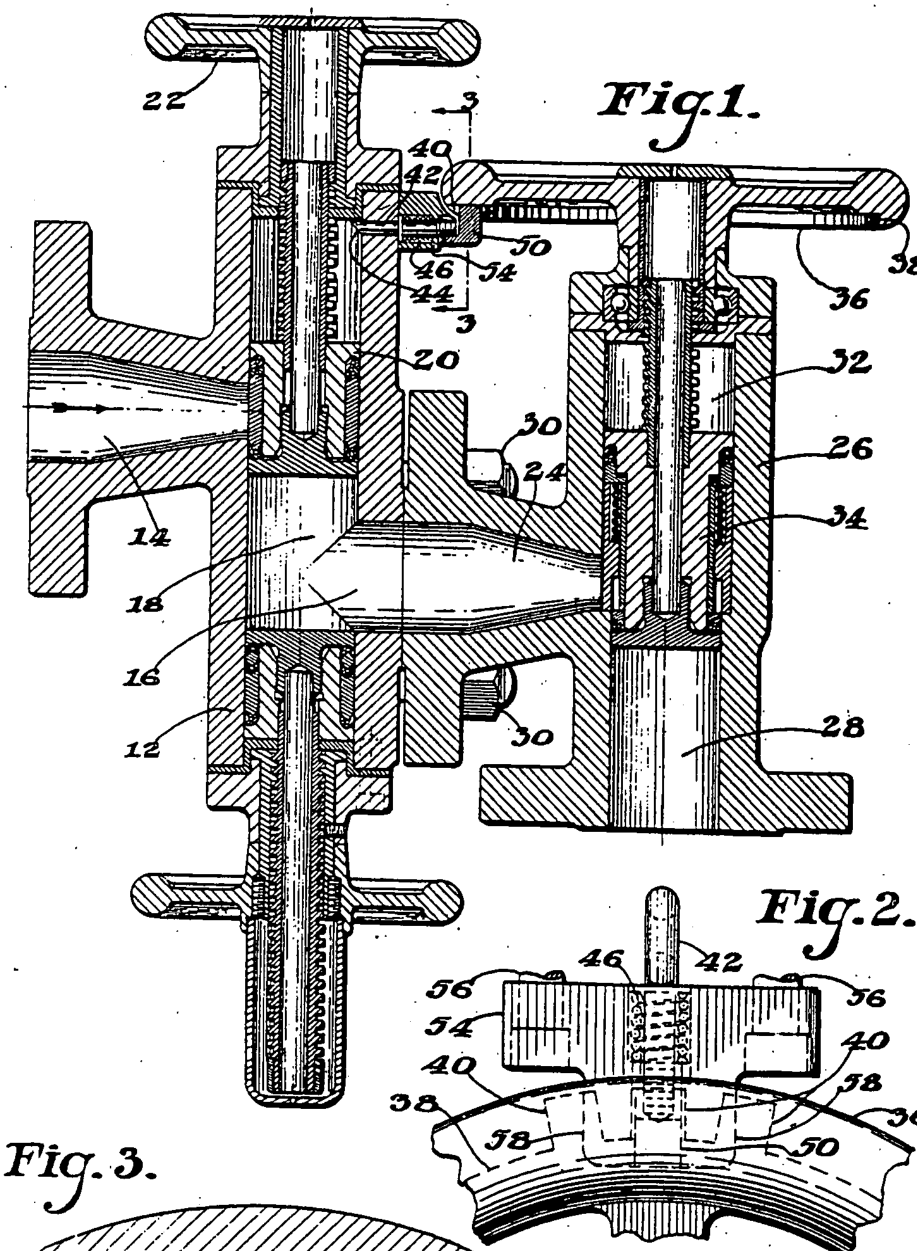
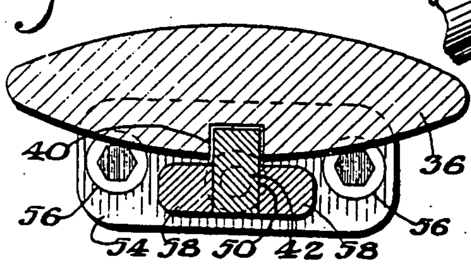


Fig. 3.



ELBERT A. CORBIN JR.
INVENTOR.

BY Louis Necho

ATTORNEY.

50 is in engagement with one of the locking recesses 40 and it is impossible to turn the wheel 36 in either direction as long as the valve piston 20 is at any point in the valve chamber 18 below the cam face 44 of the latch 42. Only after the wheel 22 has been turned to lift the valve piston 20 to its uppermost position and thus completely open the left hand valve is it possible to turn the wheel 36 for the reason that the valve piston 20, when it rides upon the cam face 44, pushes the latch 42 outwardly, or to the right as shown in Fig. 1, thus pushing the elbow 50 outwardly from the recess 44 into the annular groove 38, whereupon the wheel 36 is free to turn. From this construction it will be clear that, if it is necessary to open the left hand valve of Fig. 1 before the right hand valve thereof, the operator cannot possibly mistake or neglect the order in which these valves must be turned on and off for the reason that the valve wheel 36 is rigidly locked against rotation until released by the manipulation of the hand wheel 22 which operates the left hand valve. While any suitable means for mounting or assembling the latch 42 in position can be used, I prefer to use the bracket 54 which is suitably secured to the valve body 12 by the bolts or the like 56. Also, in order to steady the elbow 50 of the latch 42 against lateral movement, I provide the abutments 58 which are preferably extensions of the body of the bracket 54.

It will be seen from all of the foregoing that I have devised a novel construction whereby I am enabled positively to control the manipulation of various valves designed for various purposes to which, nevertheless, must be coordinated in action for proper results, and that my novel construction possesses extreme flexibility in that it is applicable to an unlimited number of valves acting in the same or in different ways.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A pair of adjacent valves each containing a piston and each controlling one end of a common intermediate conduit, a pair of actuating mechanisms for operating the respective pistons of said valves, a latch member carried by the piston chamber of one of said valves with one end of said latch member projecting inwardly into said piston chamber and lying in the path of the piston in said chamber and the other end of said latch member projecting beyond said piston chamber and disposed adjacent the actuating mechanism of the other of said pistons, and means for normally urging said latch member into engagement with said last mentioned actuating mechanism and inwardly into said piston chamber, said latch member being adapted to be disengaged from said last mentioned actuating mechanism when it is displaced outwardly with respect to said piston chamber by the action of the piston against the end of said latch member in said piston chamber.

2. A pair of valves each containing a piston and each controlling one end of a common intermediate conduit, and means for normally locking one of said valves in its closed position until the other valve has been opened and for automatically releasing the first said valve, comprising a latch member carried by the piston chamber of one of said valves with the inner end of said latch member projecting into said piston chamber and in the path of the piston operating therein and the outer end of said latch member projecting beyond said piston chamber, a hand wheel for operating the piston of the first of said valves, a notch formed in said wheel and a spring for normally urging said latch member into engagement with said notch and inwardly into said piston chamber and into the path of the piston operating therein, said latch member being adapted to be disengaged from said notch against the pressure of said spring when said latch member is displaced outwardly with respect to said piston chamber by the action of the piston in said piston chamber against the inner end of said latch member.

3. A pair of valves each containing a piston and each controlling one end of a common intermediate conduit, and means for normally locking one of said valves in its closed position until the other valve has been opened and for automatically releasing the first said valve, comprising a latch member carried by the piston chamber of one of said valves with the inner end of said latch member projecting into said piston chamber and in the path of the piston operating therein and the outer end of said latch member projecting beyond said piston chamber, a hand wheel for operating the piston of the first of said valves, a plurality of notches formed in said wheel and a spring for normally urging said latch member into engagement with said notches and inwardly into said piston chamber and into the path of the piston operating therein, said latch member being adapted to be disengaged from said notches against the pressure of said spring when said latch member is displaced outwardly with respect to said piston chamber by the action of the piston in said piston chamber against the inner end of said latch member.

ELBERT A. CORBIN, Jr.

Patented Nov. 20, 1945

2,389,413

UNITED STATES PATENT OFFICE

2,389,413

METHOD OF PREVENTING BACKFLOW OR BACK-SIPHONAGE IN PRESSURE SYSTEMS

Frank Carlton, Los Angeles, Calif.

Original application September 26, 1941, Serial No. 412,372. Divided and this application January 17, 1944, Serial No. 518,516

7 Claims. (Cl. 137—78)

This invention relates to a method for preventing a backflow and back-siphonage in a pipe system. This application is a division of my copending application filed September 26, 1941, Serial No. 412,372, for Back siphonage prevention, anti-backflow and vacuum breaking valve and method of operation.

This invention is directed to a method of preventing backflow or back-siphonage particularly in a pipe system normally under pressure to maintain the flow therethrough in the desired direction wherein I provide for the reduction of pressure at a point in the system so that the pressure entering the zone or the induction pressure thereto is maintained greater during normal flow and at the time of cessation of flow than the eduction pressure or the pressure of the fluid leaving the zone.

In this method I also employ a means whereby this zone is drained of fluid before the eduction pressure can rise to, or become equal to, the induction pressure.

In carrying out the method embodying my invention, I employ a means to maintain a pressure differentiation between the said induction and eduction pressures and prefer to drain the zone before the eduction pressure reaches the induction pressure within the limits of the pressure differential.

It is apparent that, by so controlling the pressures, backflow or back siphonage can not occur within the system beyond the said zone because flow of fluid will not occur from a low pressure zone to a high pressure zone.

It is therefore a particular object of this invention to provide a method of controlling the flow through the supply or pipe system wherein there is provided a zone at which there is maintained a pressure differential between the induction pressure of the fluid entering the zone and the eduction pressure of the fluid leaving the zone.

It is another object of this invention to provide a method of controlling the flow within a supply or pipe system in which system there is provided a zone and where the induction pressure entering the zone is maintained higher than the eduction pressure of the fluid leaving the zone and where the zone is drained of fluid at any time where the eduction pressure approaches the induction pressure within the limits of the established pressure differential.

Another object of this invention is to provide a method of controlling the flow through a supply or service system in which there is established a pressure control zone where the pressure of the fluid entering the zone is related to the pressure of the fluid leaving the zone so as to maintain a differential between said pressures and where the pressure of the fluid leaving the zone is maintained below the pressure of the fluid entering the said zone by the pressure differential and wherein means are provided responsive to the differential pressures for draining the zone when the pressure of the fluid leaving the zone and the pressure of the fluid entering the zone approach equality within the limits of the established differential.

Another object of this invention is to provide a method of controlling the flow through a water supply or service pipe system embodying the step of maintaining a differential pressure relationship within the system so that the delivery or induction pressure is in excess of the supply or eduction pressure by an established differential and wherein a portion of the system will be drained between the delivery and supply portions of the system when the supply or eduction pressure approaches a point of equality to the delivery or induction pressure either due to the development of back pressure in the supply or eduction portion of the system or due to the development of back siphonage in the delivery or induction portion of the system.

Other objects and advantages of this invention it is believed will be apparent from the following detailed description as the same is set forth in the accompanying specification and as the same is indicated as being carried out in the preferred form of apparatus illustrated in the accompanying drawing.

In the drawing:

Figure 1 is a side elevation partly in vertical midsection of an apparatus adapted for carrying out the method embodying my invention and illustrating the apparatus in position of normal flow from the induction side at the right to the eduction side at the left.

Figure 2 is a view similar to Figure 1 and illustrating the apparatus in position where the pressure control zone is draining due to the development of the condition of backflow or back-siphoning.

In accordance with the method involving my invention, I prevent backflow or back-siphonage from the eduction to the induction portions of the pipe system by maintaining the fluid pressure in the supply or eduction line during normal flow and at the time of cessation of normal flow below the fluid pressure in the delivery or induction line.

Nov. 20, 1945. F. CARLTON 2,389,413

METHOD OF PREVENTING BACKFLOW OR BACK-SIPHONAGE IN PRESSURE SYSTEMS

Original Filed. Sept. 26, 1941

Fig. 1

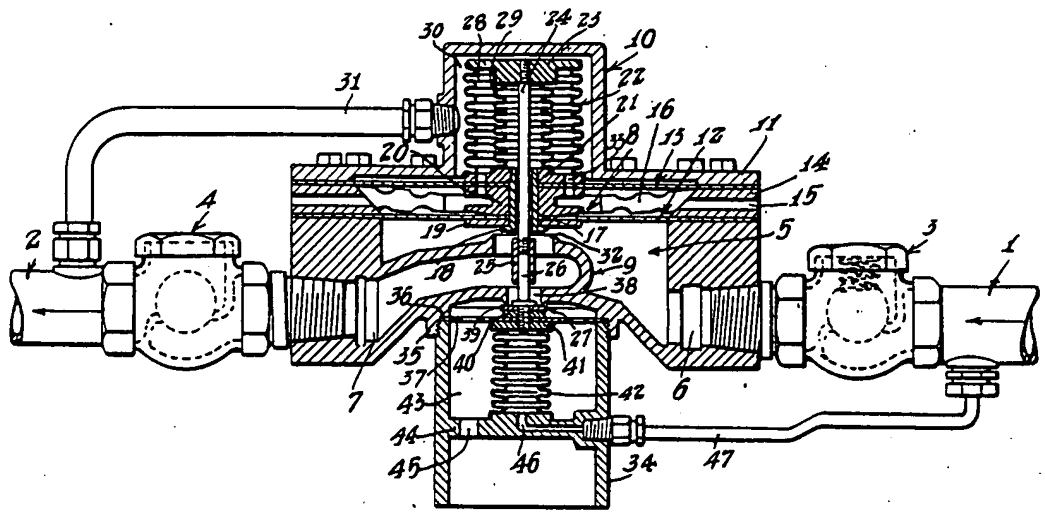
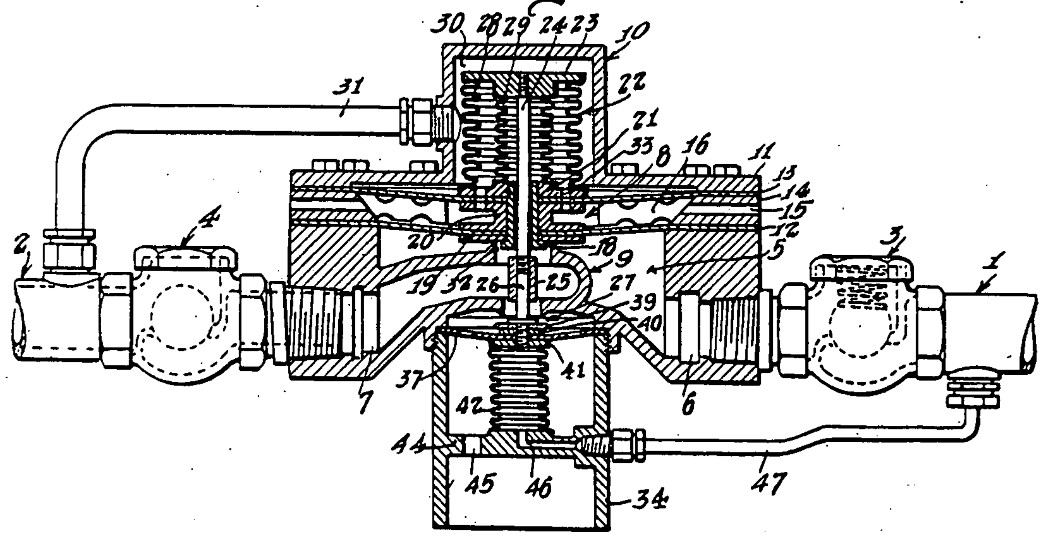


Fig. 2



Inventor

Frank Carlton

By Lyon & Lyon

Attorneys

In order to so maintain the pressures, I employ what may be defined as a presure differential regulator. By pressure differential regulator I mean a pressure regulator which will, under normal conditions, operate to maintain the pressure in the supply or eduction line below the pressure in the delivery or induction line irrespective of pressure fluctuations in the said delivery line.

In the preferred form of my invention as herein illustrated, I have shown one type of pressure differential regulator which functions due to the maintenance of differential areas against which the fluid pressures within the induction and eduction lines are effective.

The method involving this invention may be carried out through the utilization of the apparatus so illustrated which includes an induction pipe 1 which, for example, may be a line from a water distributing main. The eduction tube 2 may be connected with any service system or device to which water under pressure is delivered. Commonly employed in such a system is an induction check valve 3 and an eduction check valve 4 which normally open in the direction of flow and normally close under a condition of backflow. Between these valves, or between the induction line 1 and the eduction line 2 I establish a pressure differential zone by mounting a chamber device 5. This chamber device 5 has an induction passage 6 and an eduction passage 7 and a main valve 8 operating in conjunction with the dividing partition 9 to separate the chamber member 5 between the induction passage 6 and the eduction passage 7.

I employ means operative in conjunction with the zone established by the chamber member 5 for maintaining a pressure differential between the pressure of the fluid entering this zone through the induction passage 6 and as leaving the eduction passage 7. This pressure differential may be established as a definite pressure drop, i. e., a definite reduction in pressure which prevails irrespective of fluctuations of the pressure in the line 1 and induction passage 6, or as set forth in this preferred example, may be related to the induction and eduction pressures by subjecting a differential pressure regulator to these pressures.

I have herein illustrated one form of pressure regulator at 10 which is housed within the cap 11 of the chamber member 5. The differential regulator as herein illustrated includes an induction pressure diaphragm 12 and an eduction pressure diaphragm 13. Suitable means are provided for holding these diaphragms in spaced relation and for venting the space between the diaphragms to the atmosphere, which means as herein illustrated includes an annular ring 14 having a plurality of transverse bores 15 leading from the atmosphere to the space between the diaphragms 12 and 13. In order to maintain the diaphragms held in the spaced relation defined by the ring 14, there is carried by or secured to the ring a spacing spider 16 which is of a width corresponding substantially to that of the ring 14 and extends diametrically inward toward the center of the diaphragms to prevent their collapsing one against the other. The diaphragms 12 and 13 are secured at their center to the main valve 8 by any suitable means as, for example, by means of the hollow sleeve member 17 provided at one end with a shoulder 18 to bear against a seat member 19 which is mounted upon the sleeve 17. Mounted between the diaphragms 12 and 13, likewise upon the sleeve member 17, is a spacing spool 20. Threaded to the upper end of the sleeve member 17 is a base member 21 of the compound bellows 22. Secured to the head element 23 of the compound bellows 22 is a relief valve rod 24 which extends through the sleeve 17 and is connected at the slide joint 25 to the stem 26 of a relief or discharge valve 27.

The compound bellows 22 includes two concentrically disposed bellows elements 28 and 29 which are secured in fluid-tight relation at their lower ends to the member 21 and at their upper end to the head element 23.

The diaphragm 13, in conjunction with the ring 14 and the valve structure 8, forms a chamber 30 within the cap 11 and this chamber is maintained in communication with eduction fluid by means of the conduit 31 which extends from the chamber 30 to the eduction line 2 beyond the eduction check valve 4, thus the chamber 30 is at all times subject to the pressure of the eduction fluid. The eduction pressure in this chamber 30 is also impressed upon the large diaphragm 13, tending to move the valve 8 to its seating position upon its seat 32 formed around the flow passage formed through the partition 9.

The interior of the bellows 28 is open to atmospheric pressure through the ports 33 formed through the upper flange of the spacing spool 20, the upper diaphragm 13 and the base element 21 of the compound bellows 22. The bellows 29 is therefore subject to atmospheric pressure on its outer surface and upon its inner surface is subject to the pressure of the fluid existing within the passage formed through the partition 9.

The pressure in chamber 30 also acts externally on bellows 28 tending to move the head 23 downwardly and is opposed by the induction pressure inside the bellows 42 and the pressure inside bellows 29. Bellows 28 and 29 are free to move independently of diaphragms 12 and 13, and therefore the discharge or vent valve 27 opens or closes in response to eduction and induction pressures, induction pressure acting to close, and eduction pressure acting to open said relief valve. The induction diaphragm 12 is subjected to the induction pressure within the induction chamber formed in the chamber member 5.

As herein illustrated, the discharge or vent valve 27 is supported within a discharge cylinder 34 which is threaded to the chamber member 5 within the annular thread flange 35. Interposed between the end of the cylinder 34 and the shoulder 36 of the flange 35 is a perforated flexible washer 37. The discharge valve 27 operates to control flow of fluid through the discharge passage 38 formed through the chamber member 5 immediately below the main valve 8 and is operative to discharge fluid from the eduction chamber formed in the chamber member 5 by the partition 9 when the main valve 8 is seated. A discharge valve is carried upon the valve stem 26 and the valve disc 39 thereof is carried upon a disc 40 which is held clamped against the perforated washer 37 which in turn is held seated upon the head element 41 of the discharge bellows 42 by means of threading stem member 26 to the head element 41.

The discharge or vent bellows 42 is housed within a chamber 43 formed by the cylinder member 34. The cylinder member 34 has a transverse partition 44 formed therein in which there is an atmospheric vent port 45. This subjects the exterior of the bellows 42 to atmospheric pressure. The interior of the bellows 42 is subject to the induction pressure through a port 46 formed in the transverse partition 44 and a con-

duit 47 which is connected with the cylinder element 34 at the port 46 and to the induction line 1 beyond the induction check valve 3.

The method embodying my invention is carried out in this apparatus as follows:

Under normal operation as illustrated in Figure 1, fluid under pressure is transmitted through conduit 47 to the interior of bellows 42, causing relief valve 27 to close. Fluid then passes through the induction check valve 3 into chamber 5, and operating against the under side of the smaller diaphragm 12, raises the main valve 8 from its seat, permitting the fluid to pass the eduction check valve 4 and into the eduction line 2. During this flow, the eduction pressure acts upon the upper side of the larger diaphragm 13 and tends to close the main valve 8, thereby maintaining a predetermined pressure differential between the induction fluid and the eduction fluid during normal flow, and irrespective of any pressure fluctuations which may occur in the induction line 1. This pressure differential is also maintained at the instant of cessation of flow.

After normal flow ceases, should a backflow condition develop due either to the rise of pressure in eduction line 2 or to the drop in pressure in induction line 1, the following action will result. Suppose for example that the eduction pressure rises and that the normal pressure differential is decreased. First, the main valve 8 is simply pressed more firmly into its seat. Further rise in the eduction pressure will cause bellows 28 to compress and open the drain valve 27 slightly, thereby reducing the pressure in passage 7. The relative diameters of bellows 28, 29 and 42 are so proportioned that drain valve 27 will start to open while the eduction pressure is still slightly below the induction pressure. If the eduction pressure continues to rise, the pressure in passage 7 will continue to drop and will finally reach zero when the eduction pressure is a predetermined amount above the induction pressure. In all cases, however, the pressure in passage 7 is below the induction pressure.

I will also assume a backflow condition wherein the eduction check valve 4 has become inoperable, and it is therefore possible for fluid to flow through it in the reverse direction. If the eduction pressure in line 2 approaches the induction pressure in line within the pressure differential, the main valve 8 will close more firmly, but the relief valve 27 will open and drain fluid from passage 7, and also drain the eduction line 2 through the faulty check valve 4. Fluid will continue to drain from relief valve 27 until the proper pressure differential between the induction and eduction pressures has been restored.

It will be observed that as herein illustrated, my method is carried out by maintaining a proportionate pressure differential, that is, a pressure differential which is proportioned to the induction and eduction pressures. However, this is not an essential factor of my invention as obviously other means may be employed for maintaining a pressure differential.

Having fully described my invention and the preferred manner in which the same is to be carried out, it is to be understood that my invention is not limited to the details herein set forth but is of the full scope of the appended claims.

I claim:

1. In a method of preventing backflow in a pipe system in which fluid above atmospheric pressure normally flows from an induction line to an eduction line through a connecting zone, the steps of producing under normal conditions a substantial predetermined pressure differential between the induction line pressure and the eduction line pressure such that there is a tendency for the eduction pressure to be maintained at a predetermined amount below the induction pressure during normal flow and at cessation of normal flow, and draining the zone to the atmosphere when the eduction pressure is less than the induction pressure by an amount less than the predetermined differential, and continuing draining said zone to atmosphere even though the eduction pressure subsequently exceeds the induction pressure until the predetermined differential is again reached.

2. In a method of preventing backflow of liquid in a pipe system in which the liquid above atmospheric pressure normally flows from an induction line to an eduction line through a connecting zone, the steps of maintaining during normal flow and at cessation of normal flow a substantial predetermined pressure differential between the pressure of the liquid entering the zone and the pressure of the liquid leaving the zone such that the pressure of the liquid leaving the zone is maintained below the pressure of the liquid entering the zone irrespective of variations of pressure of the liquid entering the zone and the liquid leaving the zone during normal flow and at cessation of normal flow, and venting the zone to the atmosphere when the pressure of the liquid leaving the zone is less than the pressure of liquid entering the zone by an amount less than the pressure differential existing during normal flow and at cessation of normal flow, and discontinuing the venting upon resumption of the predetermined differential.

3. A method of preventing backflow in a pipe system in which the liquid normally flows from an induction line to an eduction line under pressure higher than atmospheric pressure and flows through a connecting zone between the induction and eduction lines, the steps of maintaining a substantial predetermined pressure differential between the induction line pressure and the eduction line pressure during normal flow and at cessation of normal flow such that the eduction line pressure is maintained below the induction line pressure, and draining liquid from the zone when the eduction pressure is less than the induction pressure by an amount substantially less than the pressure differential existing during normal flow and at cessation of normal flow, and discontinuing draining upon resumption of the predetermined differential.

4. In a method of preventing backflow in a piping system through which water normally flows at a pressure greater than atmospheric pressure from an induction line to an eduction line through a connecting zone having a normally closed atmospheric vent, the steps of establishing a substantial predetermined pressure drop between the induction line pressure and eduction line pressure during normal flow and at cessation of normal flow, and draining the eduction line to atmosphere when the eduction pressure is less than the induction pressure by an amount less than the predetermined differential, and discontinuing the draining upon resumption of the predetermined differential.

5. In a method of preventing backflow in a piping system through which water flows at a pressure greater than atmospheric pressure from

... induction line to an eduction line through a connecting zone provided with a normally closed vent, establishing a substantial predetermined pressure drop between the induction line and eduction line pressures during normal flow and at cessation of normal flow, utilizing the pressure drop to maintain a closed flow system such that upon cessation of normal flow when the eduction line pressure is less than the induction line pressure by an amount not less than the predetermined pressure drop the vent is maintained closed, and draining water through the vent when the eduction pressure is less than the induction pressure by an amount less than the pressure differential established at cessation of normal reflow, and discontinuing the draining upon resumption of the predetermined pressure differential.

6. The method of preventing backflow in a water distribution system in which water normally flows at a higher than atmospheric pressure to an eduction line from an induction line which comprises the steps of establishing a substantial predetermined drop in a zone between the lines during normal flow and at cessation of normal flow and draining said zone to the atmosphere when the eduction pressure is less than the induction pressure by an amount less than the predetermined differential, and discontinuing the draining upon resumption of the predetermined differential.

7. In a method of preventing backflow in a pipe system in which water normally flows at higher than atmospheric pressure from an induction line to an eduction line the steps of establishing a substantial predetermined pressure drop between the induction and eduction lines during normal flow and at cessation of normal flow, and maintaining the pressure in the eduction line lower than the pressure in the induction line by draining fluid from the eduction line to the atmosphere when the eduction pressure is less than the induction pressure by an amount less than the predetermined differential, and discontinuing the draining upon resumption of the predetermined differential.

FRANK CARLTON.

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2,454,160

CORROSION RESISTING VALVE

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Application August 31, 1943, Serial No. 500,669

6 Claims. (Cl. 251—158)

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This invention relates to valves which are rendered substantially non-corrosive by the use of materials capable of resisting chemical attack, for the purpose of meeting the severe requirements of fields involving the use of acids and other chemicals tending to corrode metallic materials. It has been proposed heretofore to meet such requirements with valves of standard constructions except for the substitution, at the parts subjected to chemical attack, of alloys of a character more or less resistant to attack. Such constructions have been open to the objections that they are not sufficiently resistant to corrosion, are not so designed as to be readily reground when corroded to reseat the valve, and have depended for tight closure upon excessive pressure between the valve and valve seat, so as to restrict the materials available for such parts.

It has been attempted, on the other hand, to construct such valves of ceramic materials upon which chemicals have little effect, but such attempts have been open to the objection that these materials having limited strength except in compression, are very brittle, when formed in thin sections, so as to require the resort to objectionably thick walls and heavy, cumbersome designs. Furthermore, when ceramic materials are employed in non-uniform sections, they are excessively frail as against stresses resulting from changes in temperature alone, as well as stresses commonly imposed in operation, by connection with pipe lines, and the like.

One object of the invention, therefore, is to provide a valve for the above purposes in which the parts exposed to chemical attack are made of materials having the chemical resistance of ceramic compositions, but in which the body portion or housing is made with sections of substantially uniform and practicable thickness and having the strength of metal materials.

Another object is to provide a valve of the above character having a metal housing to provide the desired strength, and with all the metal surfaces lined with vitreous enamel, and with a ceramic valve head and seat, to provide a high degree of resistance to reaction with chemicals.

Another object is to provide a valve of the above type having a ceramic valve head and seat ring with uniform cross sectional dimensions and so constructed and arranged that the stresses imposed thereon by temperature changes and in operation are limited to stresses of a compressive nature.

Another object is to afford a unitary, strong and durable valve head and stem in which the

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valve head may be readily equipped with interchangeable seating surfaces of various materials for various uses.

Another object is to provide such a valve having a construction affording ready access to the valve head, valve stem and seat, for convenient repair or replacement.

Another object is to provide such a valve with means by which the seating surfaces may be readily cleaned and lightly reground without removal from the housing and without detaching the valve housing from its connections.

Another object is the provision of a valve of the above type having its inlet and outlet connections, valve parts, and operating means all contained in a single housing adapted for assembly directly with the outlet of a container or other conducting means, to serve as a flush valve.

A further object is to provide such a valve having one of its housing parts arranged for adjustment to one position to form an angle valve, and to another position to form a straight line valve.

A further object is to provide a valve having one housing part containing the outlet connection, valve parts and operating means therefor, and a second housing part adjustable to one position to form an angle valve, and to another position to form a straight line valve, with standard dimensions and flange connections in each of said adjustments.

Still another object is the provision of a corrosion resisting valve having the above advantages and capable of various adaptations, as for use, for example, as a flush outlet valve, a throttle valve, a safety valve and the like.

To these and other ends the invention resides in certain improvements and combinations of parts, all as will be hereinafter more fully described, the novel features being pointed out in the claims at the end of the specification.

In the drawings:

Fig. 1 is a central, sectional view of a valve embodying the present invention, and showing the same applied in flush relation and at a 45° angle to the flanged outlet of a liquid container or tank;

Fig. 2 is a plan view of an additional housing part for adapting the valve shown in Fig. 1 to form either a 90° angle, or straight line valve, for connection with a pipe line, or other conduit;

Fig. 3 is a central, sectional view showing the valve parts of Figs. 1 and 2 assembled to form an angle valve for a pipe line;

Fig. 4 is a longitudinal, sectional view of the valve head and stem;

Fig. 5 is a plan view partly in section, showing

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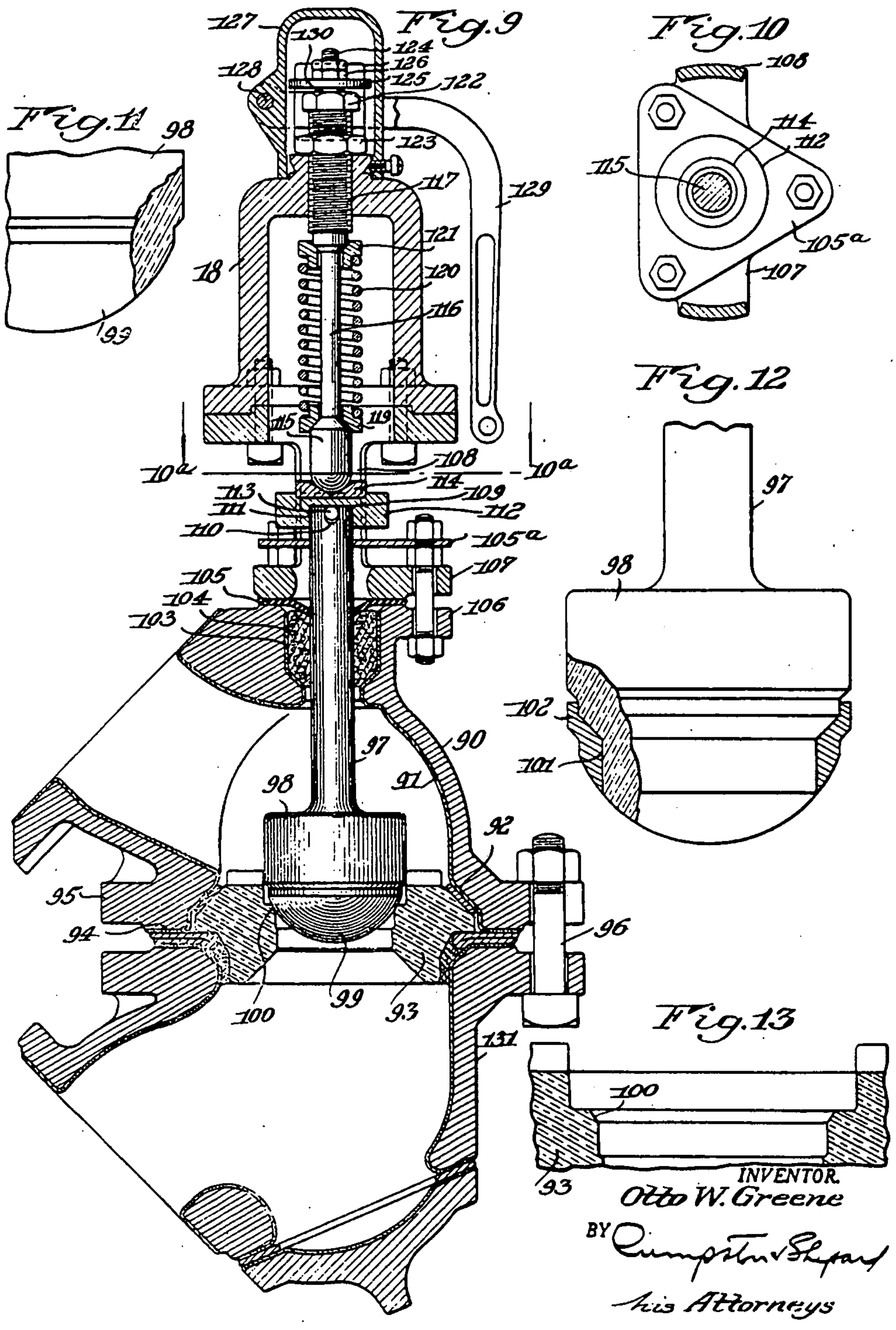

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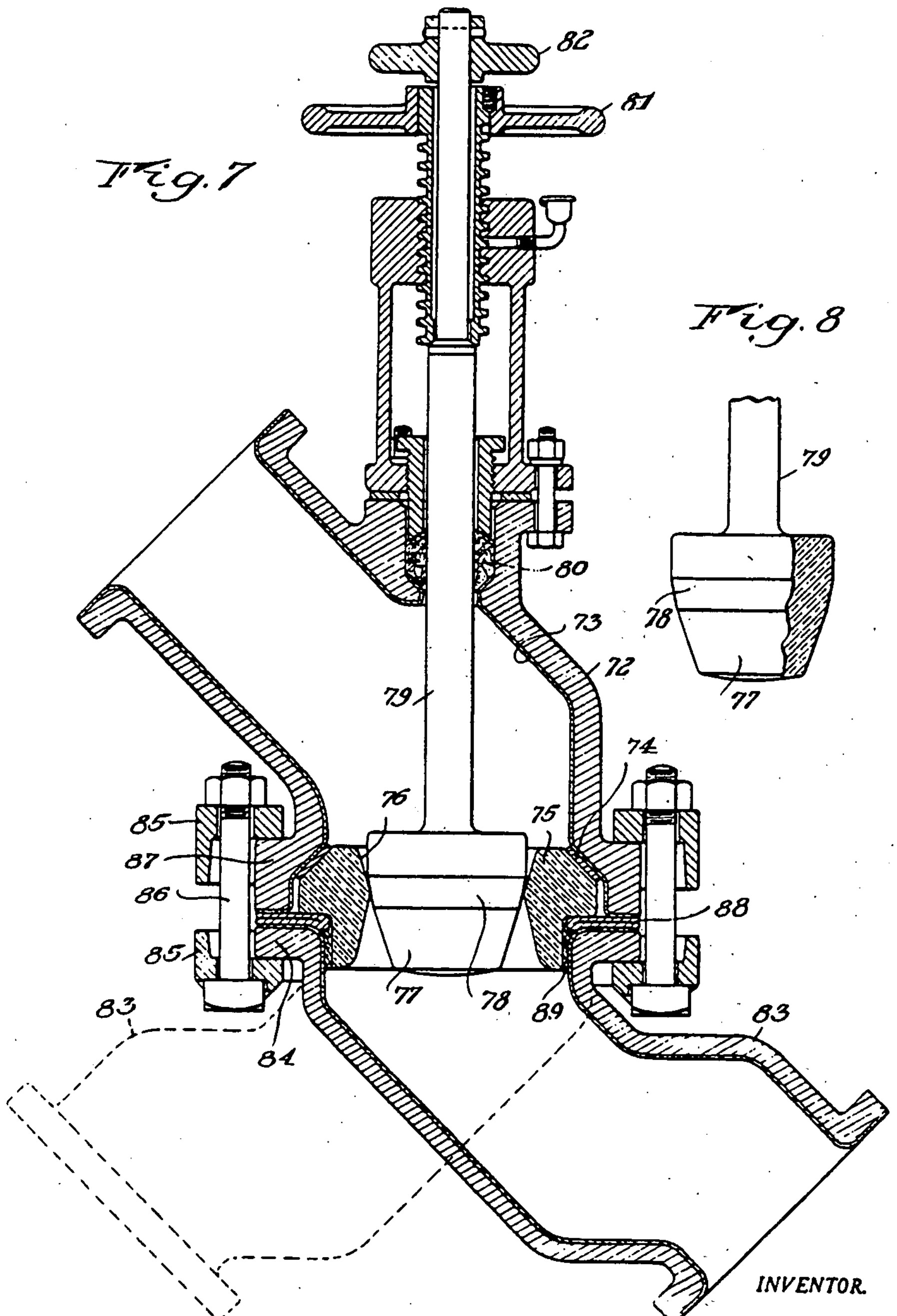
Fig. 7

Fig. 8



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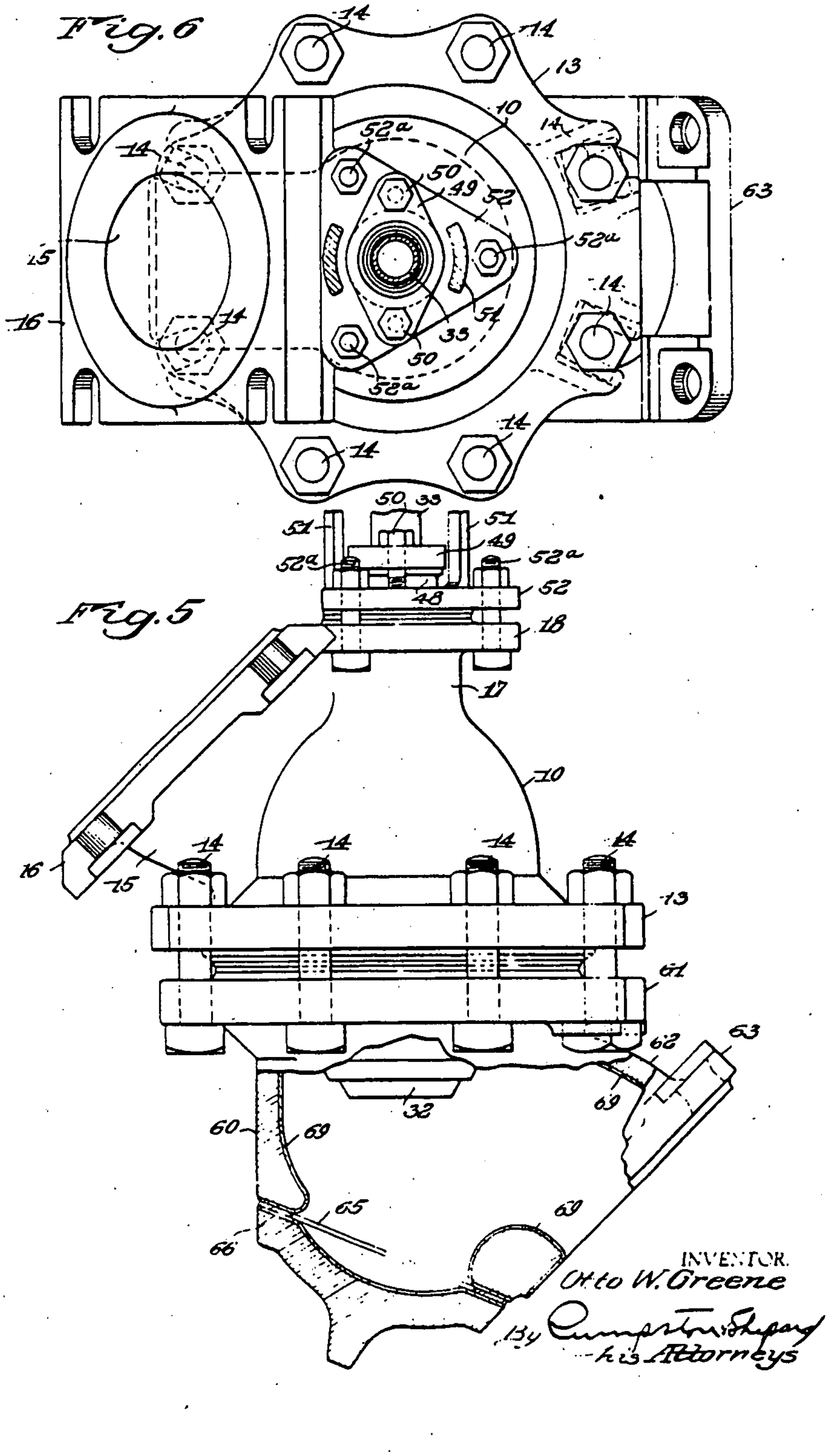

Fig. 6
Fig. 5
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Fig. 4

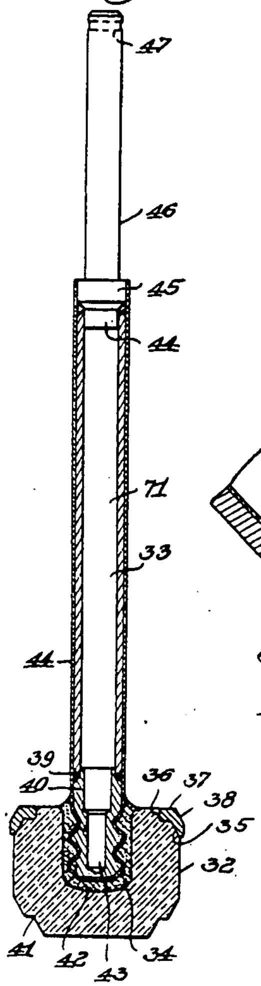
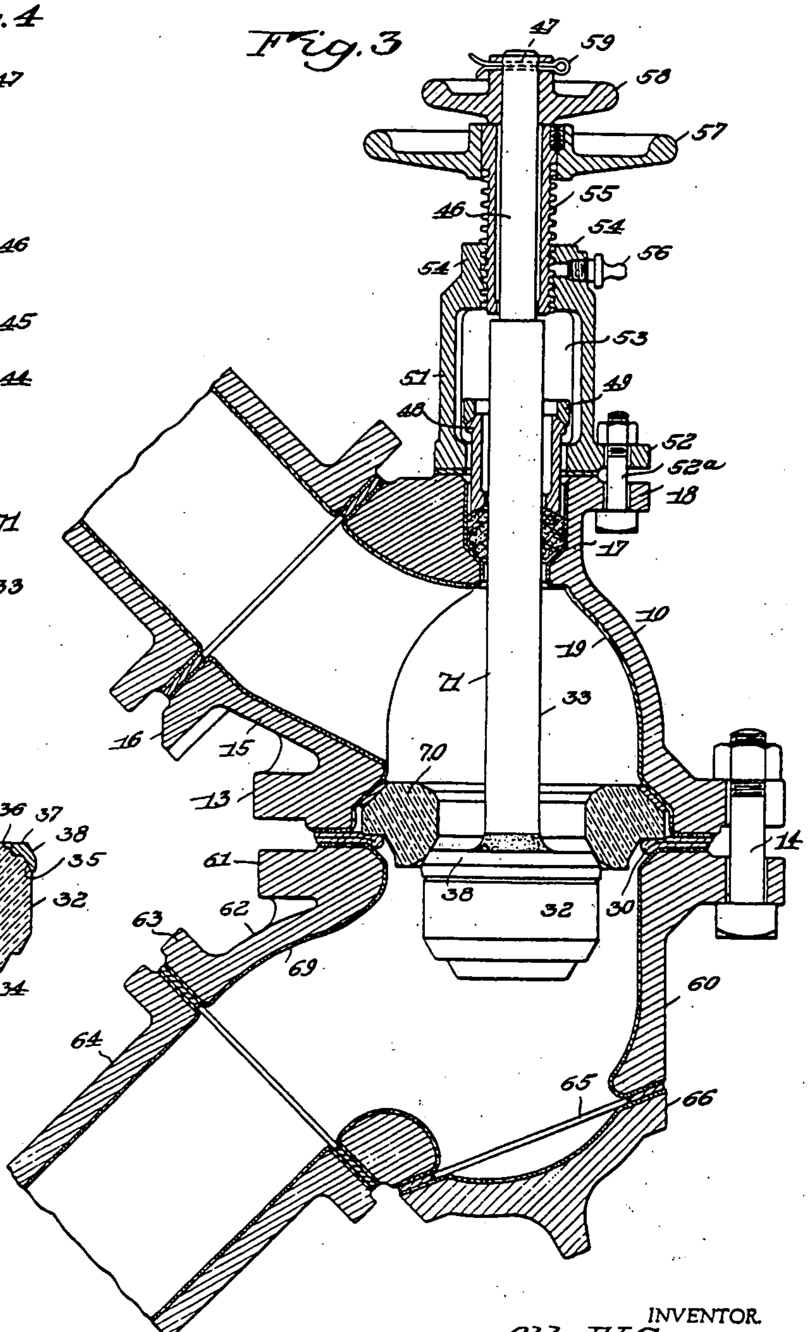


Fig. 3



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CORROSION RESISTING VALVE

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Fig.1

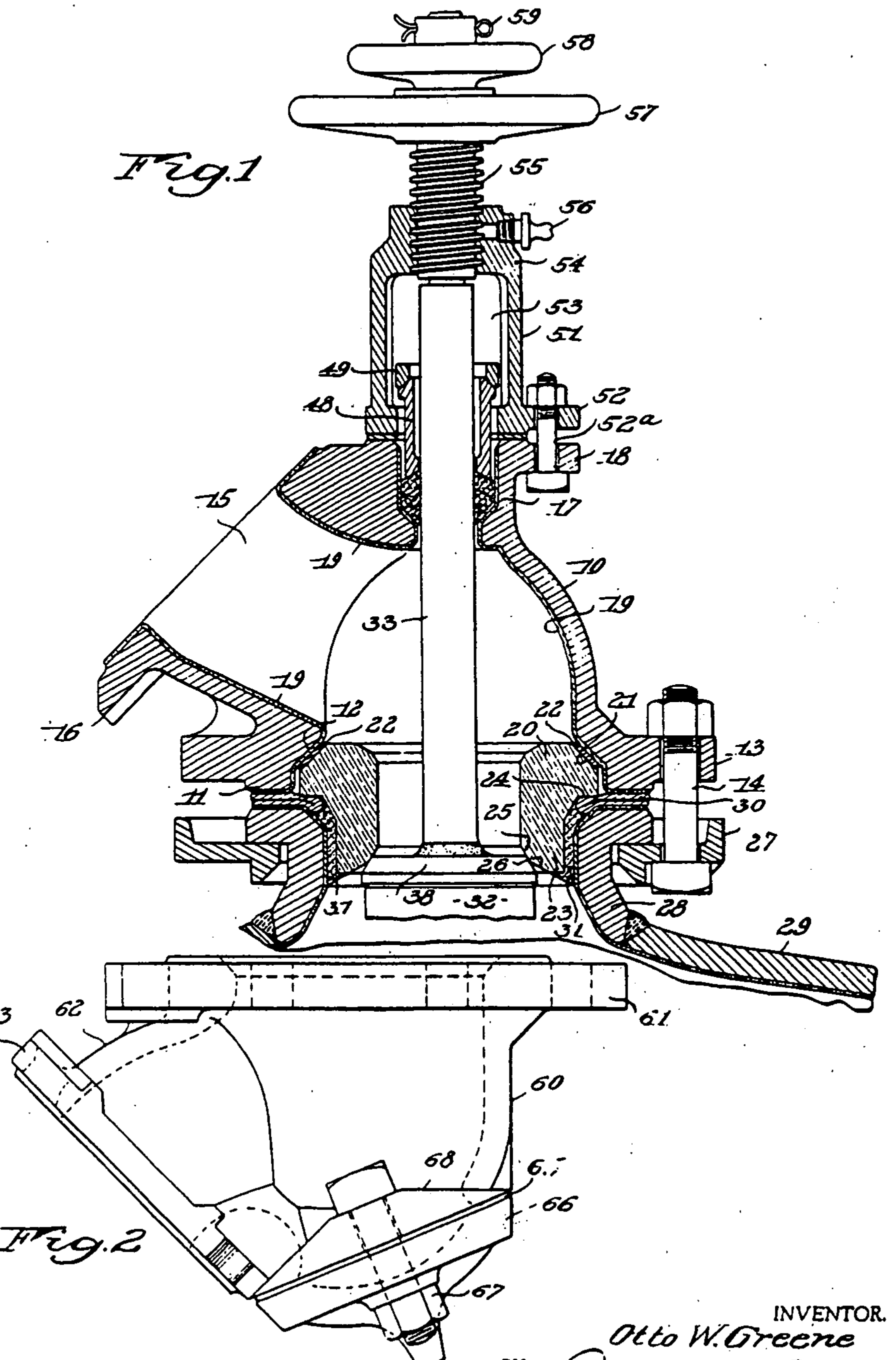

Fig.2

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the valve parts of Fig. 3 adjusted to form a straight line valve;

Fig. 6 is a top plan view of the parts shown in Fig. 5;

Fig. 7 is a central, sectional view showing the adaptation of the invention to a throttle type valve capable of being arranged as either a 90° angle valve, or a straight line valve;

Fig. 8 is a detail view, partly in section, of the valve head of Fig. 7;

Fig. 9 is a central, sectional view showing the application of the invention to a safety type valve adapted for use as either a 90° angle or straight line valve;

Fig. 10 is a sectional detail view on the line 10a—10a in Fig. 9;

Fig. 11 is an enlarged detail view, partly in section and broken away of the valve head shown in Fig. 9;

Fig. 12 is an enlarged detail view, partly in section, of a modified valve head, and

Fig. 13 is an enlarged sectional detail view of the corresponding valve seat ring.

The invention is herein disclosed, by way of illustration, in a preferred embodiment of the same and in several adaptations thereof to different uses. In one adaptation, the inlet and outlet connections, valve head and seat, and operating means therefor are combined in a single body or housing part having a flanged open side and adapted for application directly to the flanged outlet of a tank or other chemical container, to serve as a flush outlet valve. Referring more particularly to Fig. 1 of the drawings, such housing part is indicated generally at 10, as an iron or steel casting of the relatively thin and uniform cross-sectional dimensions commonly employed in standard metal valves. Housing part 10 has an inlet opening at one side 11 and is formed about said opening with an annular shoulder 12, which is inclined or flared outwardly toward said opening, preferably at an angle to the axis of the opening of about 45°, as shown, to support the valve seat, as hereafter described. The housing is formed about said shoulder and open side with a flange 13, corresponding, in the present instance, to a standard 4'' pipe flange provided with eight holes for attaching bolts 14. Housing 10 comprises also a 3'' outlet passage 15 having a flange 16 adapted for connection with a standard 3'' pipe line flange. At 17 on the housing is a valve stem stuffing box terminating in a flange 18, as hereafter described. The inner surfaces of housing part 10 are coated with a corrosion-resisting material, such as the known vitreous, or glass lining material, as indicated at 19.

The valve seat is provided on a separately formed annular ring 20 of ceramic material, preferably a good quality of porcelain, with a surface 21 flared outwardly or beveled at substantially the same angle as and seated on the shoulder 12 of the housing, a thin seating gasket of sheet packing 22 being preferably interposed to form a tight joint. Ring 20 is preferably of substantial and strong proportions, as shown, with a sleeve portion 23 projecting outwardly somewhat beyond the flanged opening of housing 10, this projecting portion having an extrenal annular recess 24 therein by which its outer diameter is reduced to less than that of the flanged opening of the housing. Projecting portion 23 has an outwardly flared or beveled portion 25 which forms the valve seat beyond which it has an outwardly flared end 26 adapted to be received within the conducting means with which part 10 is connected. It will be noted that the seat ring 20 has uniform cross-sectional dimensions to promote uniform expansion and contraction under variations in temperature.

In the adaptation of the invention shown in Fig. 1, housing part 10 is associated directly with the outlet of a tank or other container to serve as a flush outlet valve. To this end, housing part 10 has its flange 13 connected by the bolts 14 with the flange 27 of the outlet 28 of the container the body wall of which is indicated at 29. Interposed between flanges 13 and 27 is a gasket 30, of asbestos, rubber or the like. The projecting end 23 of the porcelain seat ring exends, as shown, within the outlet 28 of the tank, with a space therebetween which is preferably filled with any known or suitable, chemically resistant cement 31, to form a tight joint and a smooth and flush outflow connection with the valve seat, particularly where the tank is arranged with its outlet at its bottom to drain it.

The valve head preferably comprises a body 32 of ceramic material, such as a good quality of porcelain, mounted on a tubular metal valve stem 33. The valve head, in this adaptation of the invention, is located outside the valve seat and is preferably of uniform cross-sectional dimensions and strong proportions and thickness, as shown, with a recess 34, Fig. 4, for receiving the valve stem. It is well adapted to resist thermal expansion and contraction and operating stresses and is preferably formed with an annular flared or beveled surface 35 capable of cooperating directly with the valve seat 25. Preferably, the head has also an annular recess 36 in which is detachably seated a ring 37 of suitable seating material, such, for example, as hard rubber, synthetic plastics, or lead, or other metal, having a high chemical resistance. Ring 37 has an inwardly flared or beveled surface 38 adapted to seat against the surface 25 of the seat ring 20. Ring 37 has a pressed fit with the annular recess in the valve head, but may be replaced by a ring of the same or another material, as particular uses may require, or may be omitted altogether, so that the surface 35 of the porcelain head contacts directly with the seat ring 20. For such purposes, this ring 37 of the head is readily accessible from the exterior of the housing and without disconnecting the housing, as hereafter described.

The valve stem 33 (Fig. 4) is preferably welded as at 39 to an end piece 40, formed externally with anchoring grooves 41. The end 40 is inserted within the recess 34 of the valve head, as shown, and secured in place by an interposed filling of cement 42 interlocking with the grooves 41, as well understood in the art. End piece 40 is preferably hollowed out as at 43, to maintain a substantially uniform thickness in the walls of the tubular stem, which is covered with a vitreous enamel or glass coating 44, to protect it against chemical attack. At its other end, the stem is telescopically fitted and attached to the reduced portion 44 of an enlarged end 45 of a solid, unglazed operating rod 46, to which are attached the means for operating the stem.

The valve stem is mounted in the stuffing box 17 containing suitable packing, as shown, and having the flange 18. The gland or follower sleeve 48 is actuated by a bar 49 pressed downwardly by bolts 50, Fig. 6, threaded into the base of the valve bonnet described below.

Means are provided for operating the valve

stem, comprising means for moving it longitudinally to open and close the valve, and also means for rotating it to clean or lightly grind the seating surfaces. Such operating means comprises a valve bonnet 51 (Fig. 3), embracing the valve stem and having a lower triangular flange 52 (Fig. 6) bolted to the flange 18 of the stuffing box, as by bolts 52a. The bonnet has side openings 53 (Fig. 3) for access to the packing and an upper head 54 with a threaded central bore in which is threadedly engaged a sleeve 55 turning loosely on the operating extension 46 of the stem. At 56 is a fitting for lubricating the threaded surfaces. Fixed on the upper end of sleeve 55 is a hand wheel 57, preferably with a solid or circumferentially continuous and smooth flange, to prevent forcible engagement and turning by a tool. Above the sleeve 55 is a similar but smaller hand wheel 58 keyed to the operating extension of the stem by means of a shear pin 59 inserted in the terminal opening 47 of the stem extension. Sleeve 55 rotatably embraces the stem extension 46 between its shoulder 45 and wheel 58.

It will be apparent from the above description that, by turning wheel 57, threaded sleeve 55 is turned and moved longitudinally, to effect longitudinal movement of the sleeve stem, to open and close the valve. The continuous construction of hand wheel 57 makes it difficult to apply a wrench or other tool, thus tending to limit the force applied to the ceramic valve head and seat. By turning the upper hand wheel 58, rotary motion, only, is imparted to the stem and valve head in any position to which they may be adjusted longitudinally by means of the other hand wheel 57. In ordinary use, the valve is opened and closed by turning hand wheel 57 alone, but hand wheel 58 is occasionally rotated for the purpose of rotating the valve head, while in light engagement with its seat ring, to clean from the seating surfaces any accumulation of grit or other foreign substances, as well as to lightly grind such surfaces to maintain them in accurately mating, liquid tight engagement with each other. The applied rotary force is limited by the manual actuation of small wheel 58 and the strength of the shear pin 59.

With the valve housing part 10 and its associated parts remaining fixed to the flange outlet of a container, as shown in Fig. 1, access may be had from the container to the valve head and seat to clean the same or replace the special rings 38 on the valve body. If desired, shear pin 59 may be removed from the stem, along with the bonnet and associated parts, including the packing from the stuffing box, if necessary, and the stem may then be removed through the container for replacement or repair. By detaching the housing part 10 from the container flange, seat ring 20 may be removed for repair or replacement.

It will be apparent from the above described construction that pipe line stresses resulting from temperature changes, or the drawing together of joints, are taken by the metal body portion only, without reaching the ceramic valve head and seat elements. The latter are so shaped, associated and arranged as to receive only compressive stresses which these ceramic materials, of high compressive strength, are well adapted to sustain without injury.

Thus the seat ring 20 is spaced from the surfaces of the housing parts 10 and 28, as shown, and held between the resilient sheet packing 22 on the inclined shoulder 12 of housing part 10 and the thick resilient gasket 30 overlying the inclined shoulder of the container outlet 28 so that any pressure applied to the porcelain ring seat by clamping together the flanges 13 and 27 is resiliently limited and applied normally to its surfaces and is of the compressive nature which the porcelain material is adapted to withstand. Excessive pressure between the flanges at any part of the periphery tends to force that part of the ring inwardly and equalize the lateral pressure. Such minor lateral pressure against the ring is directed compressively inwardly against its convex periphery, in which direction also the ring is relatively strong. The moderate seating pressure of the valve head applied to surface 25 of the ring tends merely to compress it against the opposite, substantially parallel surface of shoulder 12, so that the stresses to which the seat ring are subjected are substantially limited to those of a compressive character alone. Likewise, pressure applied to the ceramic valve head 32, in closing it against its seat, is mainly a compressive force applied normally to its seating surfaces and which it is well adapted to sustain. It will be apparent also that all of the surfaces of the valve housing and its parts, which are subjected to contact with chemical contents, are composed of ceramic material which is highly resistant to chemical attack, so that the valve is completely protected.

In the manufacture of the valve, the seat supporting shoulder 12 is machined in precise conformity with the axis of the stuffing box and valve bonnet with which the stem axis coincides, and the stem assembly is manufactured by a special method to maintain its alinement with the stuffing box and seat. The high temperature at which its vitreous coating is applied tends in some cases to produce warpage in the stem and, to guard against such defects, the porcelain head is assembled and cemented to one end of the coated stem in a fixture. After the cement is dried, the head and the uncoated opposite end 46 of the stem are ground and machined in one position, concentric with the coated intermediate portion of the stem which is mounted in the stuffing box. This provides for removal of all distortions so that when the stem assembly is finished and installed in the valve, its porcelain head is positioned concentrically with the seat so that only a slight grinding of the head into the seat is required in final assembly.

The above described valve assembly in housing part 10 may be similarly applied, for example, directly to a standard 4" flange of the lateral connection of a T section of a pipe, or of any other conduit to afford a 45° angle connection, and the invention further comprises a second housing part for adapting the above valve assembly for use as either a 90° angle valve, or a straight line valve, as may be required. Such second housing part comprises a metal section 60 (Figs. 2, 3 and 5), having a 4" flange 61 adapted to be bolted to flange 13 of the housing part 10 with its axis coinciding with the axis of the valve stem. Housing part 60 is formed with a lateral inlet portion 62, having a 3" flange 63 of generally rectangular shape, provided with bolt holes for attachment to the flange of a standard pipe section 64, Fig. 3. Inlet 62 and flange 63 preferably have their axis arranged to intersect the axis of the valve stem at an angle of approximately 45°, as in the case of the outlet 15 of part 10, and flanges 63 and 16 are preferably at such a distance from the axis of the

valve stem that the valve with its inlet and outlet connections has the same dimensions from center line to flange face, as standard pipe elbows and other 90° angle sections, so as to be adapted for convenient use in any standard pipe line.

Housing part 60 may also be adjusted, relative to housing part 10, to form a straight line valve, by changing it from the position shown in Fig. 3, through 180° to the position shown in Fig. 5, where it will be seen that the axis of inlet port 62 is alined with the axis of outlet 15 of part 10. Such adjustability of part 60 makes the same valve conveniently and economically adaptable to various uses and associations.

The above described construction of housing part 60 affords the further advantage of increasing the accessibility of the interior parts of the valve. To this end the portion of housing part 60 lying substantially in line with the projected axis of the valve stem, is formed with a circular opening 65 having a diameter somewhat greater than the diameter of the valve body 32. Opening 65 is normally closed by a cover plate 66 secured in place by bolts as 67, Fig. 2, passing through the cover and through flange portions 68 at the sides of the opening. In either of the described positions of adjustment of the housing part 60, and while the valve remains connected in the pipe line, cover 66 may be removed and access thus obtained to the valve head and seat ring for inspecting or cleaning the same, replacing the ring 38 of the valve head, or the like. Or, by removing the operating means, bonnet and packing of the valve stem, as already described, so as to free the stem, it may be entirely withdrawn, with the valve head, through opening 65 for repair or replacement, as required. By this means of entry on one side of the valve seat, and by entry, if necessary, through the outlet 15 on the opposite side of the seat, the interior parts of the valve are rendered conveniently accessible for the purposes described.

The interior surfaces of housing part 60, including cover plate 66 and the flange connections, are preferably covered with any known or suitable vitreous enamel or glass lining 69, to completely protect the same against chemical attack, as described above in connection with the housing part 10 and its associated elements. The latter remain the same whether applied directly to a container outlet, as in Fig. 1, or whether employed in conjunction with the housing part 60 for adaptation to use as an angle or straight line valve, as in Figs. 3 and 5, except that, when used in connection with the housing part 60, it is preferred to employ a valve seat ring 70 projecting to a lesser distance beyond the flange 13, as shown in Fig. 3, thereby locating the valve body nearer to the housing part 10, to preserve ample clearance between the valve head and the walls of the housing part 60 in the open position of the valve. With such modification of the dimensions of the seat ring, and the position of the valve head, the valve stem 71 is correspondingly shorter.

The application of the invention to a throttle type valve is illustrated in Figs. 7 and 8. The valve there shown is generally similar in the construction and arrangement of parts to those shown in Figs. 3 to 6, inclusive, comprising a main casing or body portion 72 having a vitreous lining 73. The housing is parted and flanged, as before, adjacent the plane of the valve seat and formed with an inclined shoulder 74 for a porcelain seat ring 75 having the characteristics described above, except that it is arranged with its inclined

seating surface 76 facing inwardly of the housing. The valve head is a ceramic body 77 having a seating surface 78 for cooperation with the ring by a movement of the stem 79 inwardly of the housing. The stem and head otherwise have the construction described above and illustrated in Fig. 4, and the stem is similarly mounted for rotary and reciprocating movement in a stuffing box 80. Similar means are provided on the bonnet, operated by a hand wheel 81, for reciprocating the stem longitudinally, and a similar wheel 82 is provided on the stem for rotating it to regrind the seating surfaces.

At 83 is shown a similar auxiliary housing part for adapting the valve of Fig. 7 to serve either as a 90° angle valve or a straight line valve, as desired. Housing part 83 has a flange 84 clamped as by means of split rings 85 and bolts 86 to the flange 87 of the main housing portion 72. Interposed between the flanges is a gasket 88, as before, and, after the desired adjustment of housing part 83, its connection with the seat ring 75 is cemented as at 89, as described above, to insure a flush connection. The position of housing portion 83 shown in full lines corresponds to a straight line arrangement of the valve, while the dotted line position for portion 83 corresponds to a 90° angle arrangement, relative to the outlet on the main portion 72.

As further illustrating the wide application of the principles of the invention, they are shown in Figs. 9 to 13, inclusive, as embodied in a safety or pop valve, comprising a main housing part 90 of the same general construction already described, having a vitreous protective lining 91. The housing is formed as before with a 45° shoulder 92, compressively supporting a porcelain seat ring 93 of uniform cross section, as described. The housing is parted, as at 94, adjacent the plane of the seat and the opening so formed is provided with a flange 95 having the usual holes for bolts 96 for attachment to a flanged tank outlet, a pipe, or other connection, as desired.

This modification is equipped with an enameled metal valve stem 97 of the character described having fixed on its end a porcelain valve head 98 of the same general construction as in the previous modifications, except that it is preferred, in this instance, to form the seating surface 99 of the valve head and the cooperating surface 100 of the seat ring as portions of spherical surfaces, affording, in effect, a ball seat valve, the accurate seating of which is not affected by small variations in the angularity of the valve stem. Instead of forming the spherical seating surface on the porcelain head, the head may be suitably recessed as at 101, Fig. 12, and provided with an attached seating ring 102 of some special seat material as described above.

Prior safety valves have commonly been subject to the defect of excessive frictional resistance in the packing for the stem which has caused it to stick before opening and also delay its closing. I have found that this difficulty may be overcome by filling the stuffing box 103 with a loose barrier packing 104, preferably loose asbestos packing, the vitreous lining of the housing being carried up through the stuffing box, as shown. To seal the joint about the stem, as well as to retain the loose packing in the stuffing box, a flexible diaphragm 105 is secured on the top of the stuffing box, as by clamping it between the flanged outlet 106 of the housing and the bottom flange 107 of the bonnet 108. Diaphragm 105 is preferably formed of some suitable rubber-like material,

such as flexible natural or artificial rubber, and has an opening closely embracing the enameled valve stem, under elastic tension, so as to seal the joint about the stem and hold in the loose packing. The diaphragm flexes as the stem moves and so moves with it, being shown in the drawing inclined downwardly in following the downward seating motion of the stem. The loose asbestos packing 104 substantially retains the liquids and gases within the housing, while diaphragm 105 completes the seal and holds the loose packing in place, without any substantial frictional resistance to the movement of the stem. These packing parts provide a mounting for the stem, but it has been found preferably to provide additional means for more closely confining and guiding the stem, comprising preferably a metal plate 105a having an opening in which the stem is closely but loosely fitted, the plate being supported at its edges on the bonnet attaching bolts.

This modification also is provided with means for conveniently grinding in the valve parts, as well as regrinding the same while in operation. For this purpose, the upper end of the stem 108 is notched at 110 and seated in a recess 111 in a knurled disk or hand wheel 112, which has extended across its recess a rod 113 engaged in the slot 110 of the stem. Disk or wheel 112 is thus mounted on the top of the stem, for reciprocation therewith in the opening and closing of the valve and furnishes a means for manually rotating or oscillating the stem while lightly seated, to grind or regrind the valve parts.

Fitted in a shallow recess in the top of disk 112 is a second disk 114 having a recess in its upper side in which is rotatably seated the spherical lower end 115 of a spindle 116 slidably reciprocating at its upper end in an externally threaded sleeve 117. Sleeve 117 engages in a threaded opening in the top portion 118 of the bonnet. Riding on the enlarged lower end 115 of the spindle is a collar 119 forming a seat for the lower end of a compression spring 120 surrounding the spindle and bearing at its upper end against a collar 121 seated against the lower end of the sleeve 117. The upper end of sleeve has fixed thereon a nut-like head 122 by means of which the sleeve may be turned to adjust it longitudinally in the bonnet and so adjust the compressive force of the spring on the spindle, the disks 112 and 114 and on the upper end of the valve stem 97, for urging it toward its seat. At 123 is a lock nut for securing the sleeve in adjusted position.

Spindle 116 is extended upwardly beyond the sleeve 117 as at 124, and carries a laterally extending washer 125 secured on the spindle by means of lock nuts 126. A hood 127 on the top of the bonnet encloses the above parts and furnishes a pivotal support 128 for a lever 129 which is branched at its upper end so as to loosely surround the hood. Each lever branch is formed with a shoulder 130 engaging the under surface of the washer 125 so that when the lever is lifted, it lifts spindle 116 in sleeve 117 to relieve the valve stem from the downward pressure of spring 120 and permit it to be opened by the pressure in the valve housing. The valve stem thus has, as described above, a reciprocating motion and also a rotary motion imparted by the wheel 112 for grinding the valve parts. During transportation and storage of the valve, the lock nuts 126 may be screwed down to hold the spindle 116 up against the pressure of spring 120, so as to relieve the downward pressure of the valve head on the seat and for grinding in the valve parts,

the lock nuts are backed off sufficiently to produce just enough downward pressure of the head on the seat, to give firm resistance to turning of the disk or wheel 112, the valve parts being previously wetted, as well understood in the art. In operation, the lock nuts 126 are backed off so that the full adjusted pressure of spring 120 is applied to the valve stem.

It will thus be seen that the valve parts may be ground in without removing the valve from the line, or loosening the bonnet from the valve, or detaching any parts other than the hood 127, and such grinding or regrinding of the parts may, in fact, be carried on in a practicable way while the valve remains in operation.

It will be noted also that the valve spring and all of the operating parts are located above the packing through which the glass coated stem extends and outside the housing so as to be free from attack by corrosive liquids and gases passing through the valve.

This modification also may be provided with an auxiliary angular housing part 131, as described in connection with the above modifications, for adapting the valve for use as either a 45° angle or a straight line valve.

The invention thus accomplishes its purposes by providing a valve housing having the strength and compactness of metallic material, combined with the full protection against corrosive attack supplied by interior surfaces of ceramic materials, the valve head, stem and seat elements being readily assembled and precisely alined in concentric relation and effectively protected in operation against other than limited compressive stresses such as the ceramic materials are well adapted to withstand. The valve head may be readily fitted with seating rings of various materials to adapt it for various uses. The parts within the housing are readily accessible for inspection, cleaning, or removal, and the tight seating of the mating surfaces may be maintained by light grinding treatment conveniently accomplished, from time to time, through rotation of the valve head in contact with its seat, by means of the separate operating wheels provided for that purpose, all without detaching any of the valve parts or the housing from its connections. The parts may be reground, in fact, while remaining in operation. The durable porcelain valve head and seat are thus capable of remaining in precise, liquid tight, mating relation with each other for indefinite periods of time.

While the invention has been disclosed by reference to the particular details and dimensions of a preferred embodiment, it is to be understood that such disclosure is intended to be merely illustrative, rather than by way of limitation, as it is contemplated that various modifications in the construction and arrangement of the parts will readily occur to those skilled in the art within the spirit of the invention and the scope of the appended claims.

I claim:

1. An acid-resistant valve comprising a metal housing having a vitreous enamel lining, said housing having a body part and a conducting part each formed with an opening at one side thereof and with a connecting flange about said opening, means for drawing said flanges into seating engagement with each other, said body part having its wall flared outwardly at said opening to a diameter larger than that of the opening of said conducting part and forming an inwardly inclined shoulder about said opening, a separately formed ceramic seat ring having an inwardly inclined

surface lying against said shoulder and an abutment overlying the flange of said conducting part, sheet packing between said ring surface and shoulder, resilient rubber-like gasket means between said ring abutment and said flange of said conducting part for supporting said ring with an inwardly directed, resilient compressive force for centering the same in said opening, a metal valve stem mounted in said housing and having a vitreous enamel coating, a valve head on said stem having a surface of corrosion resisting material, and means for operating said stem to open and close said valve.

2. In a corrosion resisting valve, a metallic valve body having a conducting opening formed with an inwardly inclined shoulder, a connecting flange about said opening, a metallic conducting part having a connecting flange, said body and part having their inner surfaces lined with a vitreous enamel and said flanges having cooperating seating surfaces and means for drawing the same together, a metallic valve spindle movably mounted in said body and having a vitreous enamel coating, a valve head on said spindle having a surface of corrosion resisting material, a separately formed ceramic valve seat having an inwardly inclined shoulder cooperating with said body shoulder and also a surface for cooperation with said conducting part, said seat being spaced from said body and part, and resilient gasket material between said seat and part and between said seat and body shoulders for centering said seat relatively to said body opening and valve head by resilient pressure thereon between said part and said body shoulder and for limiting transmission to said seat of stresses occurring between said body and part.

3. In a corrosion resisting valve, a valve body having a conducting opening flared outwardly to form therein an inclined shoulder, a connecting flange about said opening, a conducting part having an opening of less diameter than said body opening to form therewith an annular recess, a connecting flange about said opening of said conducting part, said body and part having inner surfaces of corrosion resisting material and said flanges having cooperating seating surfaces and means for drawing the same together, a valve spindle and head movably mounted in said body and having surfaces of corrosion resisting material, a separately formed seat ring of corrosion resisting material having an outwardly extending flange located in said recess with one side thereof cooperating with said conducting part and the other side thereof inclined for cooperation with said body shoulder, said ring being spaced from said body and part, and resilient gasket material between said ring flange and said part and body shoulder for centering said ring relatively to said body opening and valve head by resilient pressure thereon applied by said means for drawing said flange seats together and for limiting tne transmission to said seat of stresses occurring between said body and part.

4. In a corrosion resisting valve, a valve body having a conducting opening formed with an inwardly inclined shoulder, a connecting flange about said opening, a conducting part having a connecting flange, said body and part having inner surfaces of corrosion resisting material and said flanges having cooperating seating surfaces and means for drawing the same together, a separately formed valve seat of corrosion resisting material having an inwardly inclined shoulder cooperating with said body shoulder and also a surface for cooperation with said conducting part, said seat being spaced from said body and part, resilient gasket material between said seat and part and between said seat and body shoulders for centering said seat relatively to said body opening by resilient pressure applied by said means for drawing said flange seats together and for limiting the transmission to said valve seat of stresses occurring between said body and part, a valve spindle having a corrosion resisting surface mounted for movement in said body and extending through said seat, and a valve head on said spindle having a surface of corrosion resisting material for cooperation with said seat on the side thereof opposite said body shoulder, said conducting part being formed to provide clearance for the opening and closing movements of said valve head.

5. In a corrosion resisting valve, a valve body having an outwardly flared conducting opening provided with a connecting flange, a conducting part having an opening of less diameter than said flared body opening to form therewith an annular recess and provided with a connecting flange, said body and conducting part having inner surfaces of corrosion resisting material and said flanges having cooperating seating surfaces and means for drawing the same together, a separately formed seat ring of corrosion resisting material located in said recess and having a sleeve extending into the opening of said conducting part, resilient gasket material separating said ring from said part and resiliently supporting said ring in said recess, a valve spindle having a corrosion resisting surface mounted for movement in said body and extending through said ring, and a valve head on said spindle having a surface of corrosion resisting material for cooperation with said ring sleeve, said conducting part being formed to provide clearance for the opening and closing movements of said valve head.

6. In a corrosion resisting valve, a metal housing having a corrosion resisting lining and parted transversely of the flow passage therethrough to provide a body part and a conducting part, each of said parts having an opening provided with a connecting flange, said body part having an inwardly inclined shoulder therein about said opening, one of said housing parts having an outlet and the other having an inlet each arranged with its axis at an angle of 45° with said connecting flanges, means for drawing said connecting flanges into adjustable seated engagement with each other to form either a straight line valve or an angle valve, a separately formed seat ring of corrosion resisting material having surfaces cooperating with said shoulder and conducting part, resilient gasket means interposed between said ring and conducting part for centering said ring on said shoulder by an inwardly directed, resilient compressive force, a valve stem and valve head movably mounted in said body part and having corrosion resisting surfaces, and means for moving said stem to move said head toward and from said ring, said housing parts being formed to provide clearance for the said movements of said valve head.

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Patented July 18, 1950 2,515,425

UNITED STATES PATENT OFFICE

2,515,425

AUXILIARY VALVE FOR SUCTION CLEANERS

Edward F. Restemeier, Toledo, Ohio, assignor to Air-Way Electric Appliance Corporation, Toledo, Ohio, a corporation of Delaware

Application March 21, 1946, Serial No. 656,145

1 Claim. (Cl. 183—39)

1

This invention relates to suction cleaners, and particularly to vacuum cleaners of the type in which the filter unit and the motor operating suction unit are totally enclosed by a connecting housing, reliance being had on the passage of exhaust air for motor cooling purposes during operation.

Periodically, sufficient dirt separates from the incoming air and collects in the pores of the filter bag effectively to resist the passage of air therethrough, and for various other mechanical reasons the passage of air into the suction housing is resisted. Under such conditions the amount of air flowing by the motor casing is insufficient to prevent overheating thereof to dangerous temperature ranges.

It is an object of this invention to provide an automatic means for compensating for the reduced flow of air at reduced or near zero orifice such that the motor is cooled and maintained at safe operating temperatures.

Another object of this invention is to produce a spring operated valve which automatically provides an opening for the passage of outside air into the suction housing when the atmospheric pressure inside and outside of the suction housing have reached a dangerous differential.

A further object of this invention is to provide an improved vacuum cleaner housing having an auxiliary opening normally in the closed position, but which is automatically opened for the free passage of outside air therethrough when the normal flow of filtered air has been greatly reduced.

Other objects and advantages will hereinafter appear and for purposes of illustration and not of limitation, an embodiment of the invention is shown in the accompanying drawings in which

Figure 1 is a fragmentary elevational view of the vacuum cleaner having a side wall portion of the filter housing broken away to show the auxiliary air valve in the assembled relation.

Figure 2 is a detailed elevational view of the auxiliary valve mounted on the inside wall of the filter housing, and

Figure 3 is a sectional elevational view taken along the line 3—3 of Figure 2.

The illustrated embodiment of the invention comprises a vacuum cleaner 10 of the upright type having a filter unit 11 superposed upon a suction unit 12, the latter being completely enclosed by a cylindrical housing 13 and supported upon stationary legs 14. Positioned within the housing 13 is a motor 15 which drives a suction

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fan 16 which normally causes the movement of the air to pass through the filter unit 11 and out of the outlet passage 17 located on the underside of the cylindrical housing 13.

The filter unit 11 includes a cylindrical housing 17 having an open end 18 in registry with an opening 19 in the suction unit enabling the free passage of air from the filter unit into the suction unit after the contained dirt has been separated therefrom by means of the filter bag 21 disposed within the cylinder 17. The cylindrical housing 17 is fluted at 22 in the longitudinal direction enhancing the free passage of air downwardly toward suction unit, said cylinder having a lower end flange 23 supporting an aroma pad 24 through which the filtered air passes.

It is manfest that the separated dirt particles will eventually clog the pores of the filter bag 21 effectively to lower the flow of air therethrough, reducing the atmospheric pressure in the enclosed area outside of the filter bag and in the suction unit. It is well known to those skilled in the art that the high speed motors of the type ordinarily used in vacuum cleaners have a temperature rise limitation, and it is a desideratum to maintain the passage of sufficient air past the motor unit for cooling purposes whereby the motor temperature is controlled prolonging the life thereof. In this instance an opening 25 is provided in the lower portion of the filter housing 17 which opening is controlled by valve 26 normally preventing the passage of air therethrough, but which automatically is opened for the passage of outside air when the pressure differential between the inside and outside atmosphere is too great as a result of a substantial reduction in the flow of air through the filter unit.

The valve 26 comprises a sheet metal body portion 27 adapted to abut the inside wall of the filter housing 17, an opening 28 in the body portion being in registry with the opening 25 of substantially the same diameter in the housing wall. A plug 30 having a screw threaded barrel portion 32 extending through the registered openings is adapted to be engaged by an internally screw threaded lock nut 33 which when rotated in the direction for tightening securely locks the body portion 27 and the plug 30 in the assembled relation in cooperation with a head 34 of larger diameter than the integral barrel portion 32 and which is adapted to abut the outside wall of the cylindrical housing 17 when in the assembled relation.

An aperture 35 through the plug is normally

July 18, 1950 | E. F. RESTEMEIER | 2,515,425

AUXILIARY VALVE FOR SUCTION CLEANERS

Filed March 21, 1946

FIG. 1.

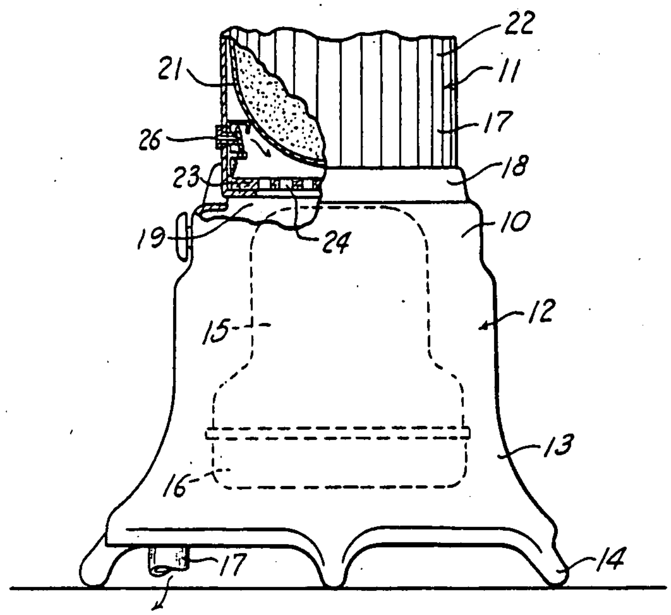


FIG. 3.

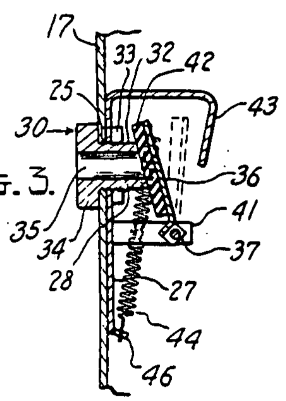
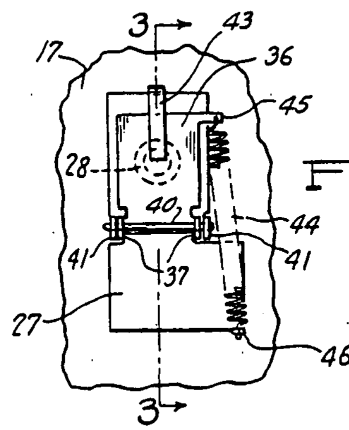


FIG. 2.



INVENTOR.
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BY Malcolm W. Fraser
ATTORNEY

closed by a door 36 having integral ears 37 extending perpendicularly downwardly from the bottom lateral edges thereof in substantial parallel relation. Openings 38 in each ear pivotally engage an axle 40 mounted upon spaced bracket arms 41 extending inwardly substantially at right angles from the integral body portion 27.

It is thus apparent that the pivotally mounted door may be rocked in the direction toward or away from the ported plug 30 such that a resilient gasket 42, secured to the surface of the door adjacent the plug, effectively seals the inside end portion of the ported plug which is inclined at an angle corresponding to the slope of the door when in the closed position.

A flange or hook member 43 integral with the upper edge of the body portion 27 provides an abutment which limits the movement of the pivotally mounted door in the direction away from the plug 30.

A coil spring 44 is anchored at one end to a arm 45 extending laterally from the upper edge of the door 36, and is anchored at the other end to a hook 46 integral with the lower edge of the body portion 27, whereby said spring is tensioned and disposed in an angular relation thus continuously to exert a force urging the door in the direction towards abutment with the ported plug 30 for closing the opening.

In operation when the passage of air from the filter unit has been reduced to the extent that the difference between the inside and outside atmospheric pressures is sufficient to create a force greater than that exerted by the spring 44, holding the door in the closed relation, the door 36 is rocked in the direction away from the ported plug allowing the passage of outside air to rush through the opening for purposes of cooling the motor 15.

To the present, description has been limited to a spring operated control valve, however, it is to be understood that other means for effecting door opening movements may be used such as a thermal regulator which operates in response to the temperature gradient of the motor unit 15 to effect door opening and closing movements.

It is manifest that I have produced a simple and automatically operating safety valve for use in combination with vacuum cleaners of the enclosed type, which valve insures the flow of sufficient air past the motor unit for maintaining same at safe operating temperatures. The described valve comprises relatively few operating elements thereby to insure faultless operation in response to forces sufficient to overcome the static force of the spring holding the valve in the closed position. The addition of the auxiliary valve does not alter the operation of the vacuum cleaner, but operates automatically under dangerous conditions to prolong the life of the mechanical elements comprising the vacuum cleaner.

It is to be understood that other changes in operation, construction and distribution of parts may be effected without departing from the spirit of the invention, especially as defined in the appended claim.

What I claim is:

A relief valve for a vacuum cleaner having a filter unit and a motor operated suction unit, interconnected housings enclosing said units, an aperture in one of said housings near their intersection, said relief valve comprising a ported plug fitting said opening, a mounting member disposed on the inside of said apertured housing and associated with said ported plug, a door pivotally mounted on said mounting member and adapted for rocking movement in a direction toward or away from said ported plug, a coil spring urging said door in the direction toward said plug closing same, said door being automatically rocked in the direction away from said plug in response to forces resulting from the atmospheric pressure differentials inside and outside of the housings when the movement of air through the filter unit has been dangerously reduced, and a stop integral with said mounting member for limiting the movement of the door in the direction away from said ported plug.

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2,556,277

SELF-OPERATING VALVE FOR AIRCRAFT COOLING SYSTEMS

Thomas Gardner Hill and Arthur N. Curl, Middle River, Md., assignors to The Glenn L. Martin Company, Middle River, Md., a corporation of Maryland

Application February 22, 1945, Serial No. 579,272

2 Claims. (Cl. 244—57)

1

Our invention relates to a valve, and more particularly to a self-operating valve for use in a cooling system.

In the construction of aircraft it is essential that various media be employed for the supplying of cool air to certain accessories of the power plant to prevent the damage which would otherwise result from the excessive heating. Turbo superchargers, heat-exchange units, exhaust pipe shrouds, and the like, become subject to excessive heat with the running of the airplane motors, and one of the primary problems is the supplying of cool air to these elements. When the plane is in motion it is relatively simple to supply "ram" or forced air, occasioned by the forward movement of the plane, to the heated parts. When the plane is on the ground, ram air is not available, and where it is necessary to run the engines under such conditions the air cooling of the accessories presents a serious problem.

It will be appreciated by those skilled in the art that it is desirable to provide a source of cooling air for the power plant accessories when the plane is on the ground and that this auxiliary source of cooling air be so arranged that it will not be dissipated through the ram air inlet. Accordingly, a device to provide the auxiliary cooling on the ground should incorporate an automatic arrangement whereby the ram air inlet is automatically closed when the plane is on the ground and will be automatically opened when the plane is in flight. Furthermore, such automatic opening and closing apparatus should be constructed and arranged so that it is stable in its open position and free from destructive flutter.

It is an object of our invention to provide, for use in an automatic cooling system comprising a plurality of cool air inlets, pivoted valve means for opening and closing one of the inlets, the valve means comprising a cambered valve body and means urging said valve body to a closed position, the urging means being substantially uniform throughout the pivoting movement of the valve body so that once the urging means have been overcome by an opposing pressure the valve will be moved through its entire arc.

It is one of the objects of our invention to provide a self-operating valve which will automatically open when the ram air is available under pressure sufficient to provide cooling, and which will close when the ram air pressure falls below such predetermined pressure so as to render fan air effective for cooling.

It is a further object of our invention to provide a valve which will be stable in its open position whereby valve flutter is eliminated.

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It is our further object to provide a valve having a curved profile which, when the valve is in its open position, is acted upon by the ram air stream to create a lifting, stabilizing force on the valve.

Another object of our invention is to provide a pivotally mounted valve of a curved contour, and a spring adapted to exert a force on the valve, the force of the spring remaining substantially constant throughout the pivoting of the valve, so that when the valve is open the lifting effect of the curved contour of the valve will prevent flutter.

These and other advantages of our invention will be apparent from the following description and from the accompanying drawings, wherein:

Figure 1 is a fragmentary plan view of an air duct showing our valve in its closed position;

Fig. 2 is a fragmentary plan view of an air duct showing our valve opened in response to ram air;

Fig. 3 is a view showing the spring closure adjusting means for the valve in the duct;

Fig. 4 is a diagrammatic view of a cooling system employing our valve; and

Fig. 5 is a view showing the location of the cooling system in the leading edge of an airfoil.

A valve body 5 comprises a cambered inner face 6 and a cambered outer face 7 held in spaced relation by any conventional reinforcing means and joined to form an edge 8 over which is placed a U-shaped cover 9. When the valve is in its normal closed position, the edge cover 9 rests upon a valve stop 10, secured interiorly to a wall 11 of an air duct 12 in which the valve is located.

The valve body is adapted to rotate on a valve pivot 13 journaled in a bearing 13A secured exteriorly of a wall 14 of the air duct 12. The projecting end of the pivot 13 is secured to the base 15 of a lever arm 16, at the exterior of the air duct.

The lever arm 16 comprises the base 15 and a head 17 having an eye 18 adapted to receive one end 19 of a spring 20 arranged to urge the valve to its closed position. The opposite end 21 of the spring engages a threaded rod 22 carried adjustably by a bracket 23 mounted on the wall 14 of the air duct. Two nuts 24 permit the easy adjustment of the rod 22 to increase or decrease the tension on the spring 20 whereby the valve opening in response to ram air is controlled.

The duct 12 may be conveniently formed, as shown in Fig. 5, by utilizing as outer walls the ribs 25 of the airfoil 26 in which it is located. An open slot 27 in the leading edge of the airfoil thereby provides the inlet for the ram air when the plane is in flight.

The operation of our valve is as follows:

When the airplane is on the ground (see Fig. 4) with its motors running there is no ram air entering the inlet A through the slot 21 in the airfoil, but positive pressure provided by power driven fans (not shown) is received through the inlet B.

With the forward motion of the plane the ram air builds up at A, and when the ram air pressure exceeds the combined effect of the fan air pressure and spring it moves the valve to its open position (see Fig. 2). To open the valve it is necessary to overcome the slight torque supplied by the spring 20 through the lever arm 16. This torque is kept approximately constant throughout the pivoting movement of the valve body, thereby ensuring that the valve will not remain in a partially open position, since once the ram air pressure exceeds the combined fan air pressure and the constant torque it will urge the valve to its fully opened position. This is achieved according to our invention by so positioning the spring and the lever arm with respect to the valve body that as the force of the spring increases, the perpendicular distance from the pivot to the line of the force decreases, thereby maintaining a substantially constant moment of force. This arrangement provides that the airfoil lift effect of the cambered valve body will hold the valve open in response to ram air flow.

When the valve body 5 approaches the side of the air duct 12 (Fig. 2) the cambered shape of the valve body and the interior wall of the duct create a Venturi type of air passage. Thus, as the ram air passes the valve body a negative pressure is created between the duct wall and the valve body which holds the valve body in its open position, adjacent the air duct wall. The importance of the stability of the valve will be appreciated by those skilled in the art who are aware of the destruction wrought in aircraft parts subjected to flutter and vibration.

As the forward motion of the plane decreases the ram air pressure drops, and as soon as it is balanced by the fan air pressure the spring 20 acts to close the valve body 5, thereby rendering the fan pressure effective in the cooling system.

We claim:

1. In an automatic cooling system for an aircraft having a duct so constructed and arranged as to be exposed to ram air during flight, a pivoted valve means located within said duct for opening and closing said duct to ram air, said valve means having an airfoil shaped valve body to produce a Venturi type passage with the adjacent wall of said duct in a fully opened position and means for urging said valve to a fully closed position to effect retention of air in the duct on a predetermined drop in pressure of the ram air, said urging means being so connected as to produce a substantially constant moment throughout the pivoting movement of said valve body.

2. In an automatic cooling system for aircraft or the like having a ram air intake duct, a valve located therein comprising a valve body pivoted within said duct, said pivot being spaced inwardly of one wall of said duct, whereby said valve body in open position, lies closely adjacent but spaced from said one wall for allowing air to pass on either side thereof, said valve body having an airfoil shape with a concave surface facing generally toward the intake opening of said duct when in closed position and a convex surface facing generally away from said intake opening when in closed position, said airfoil shape of said valve body producing lift tending to open said valve body throughout its movement from the fully closed to the fully open positions upon application of ram air at a predetermined pressure, said convex surface yielding a Venturi effect with the adjacent wall of said duct when said valve body is opened to the passage of air therethrough, and spring means so arranged as to produce a substantially constant moment on said valve body throughout the movement thereof, tending to close said valve upon a predetermined decrease in ram air pressure.

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June 12, 1951 T. G. HILL ET AL 2,556,277

SELF-OPERATING VALVE FOR AIRCRAFT COOLING SYSTEMS

Filed Feb. 22, 1945 2 Sheets-Sheet 1

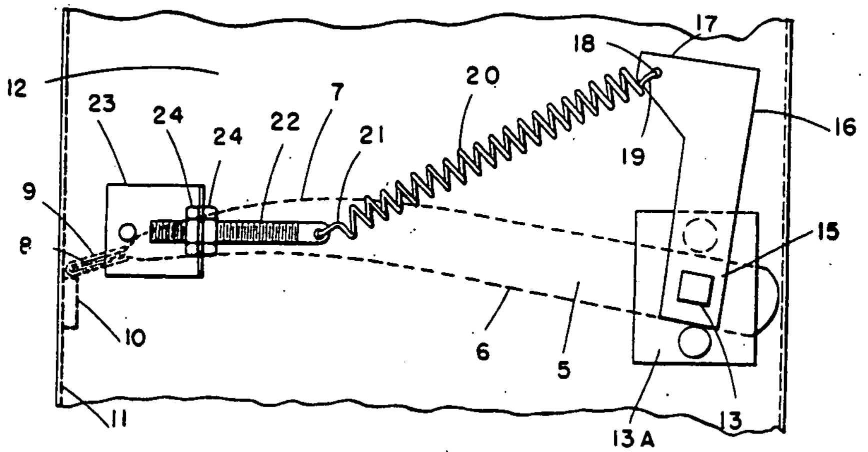
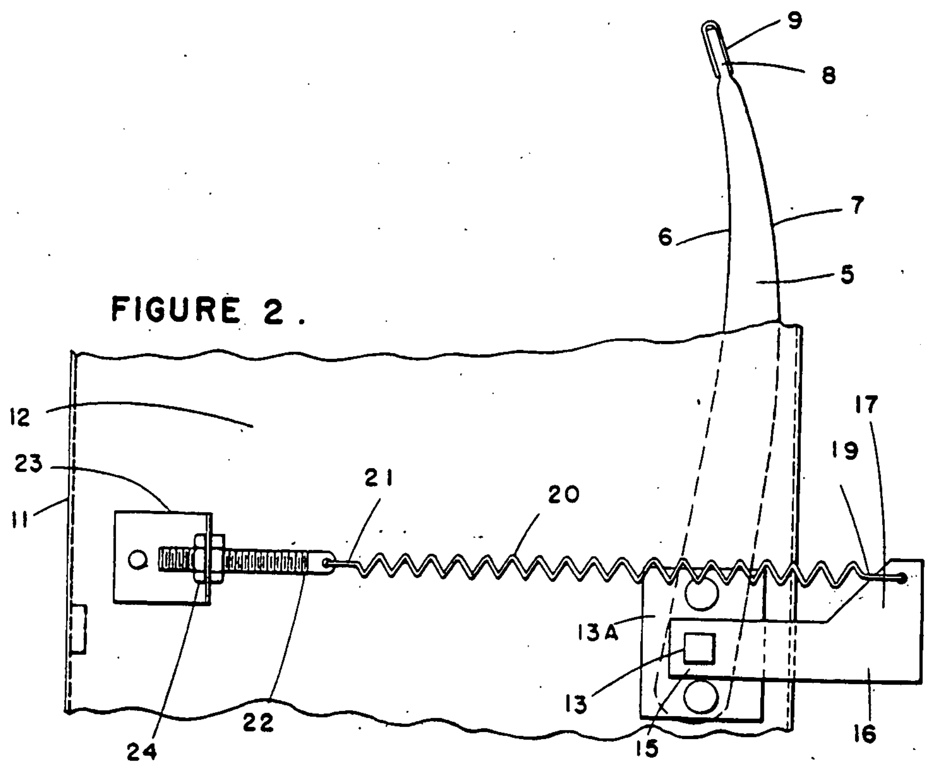


FIGURE 1.

FIGURE 2.



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SELF-OPERATING VALVE FOR AIRCRAFT COOLING SYSTEMS

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FIGURE 3 .

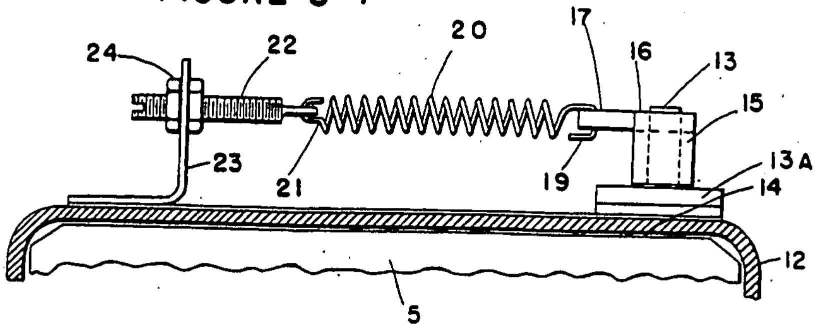


FIGURE 4 .

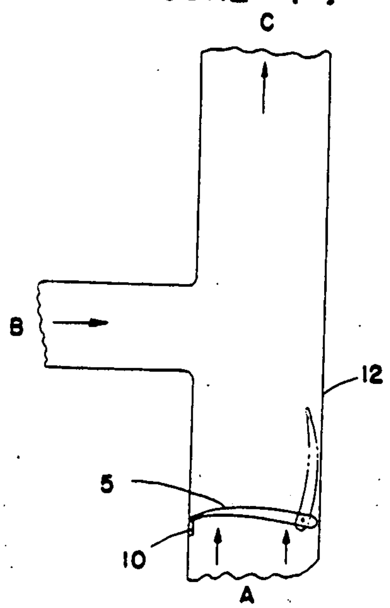
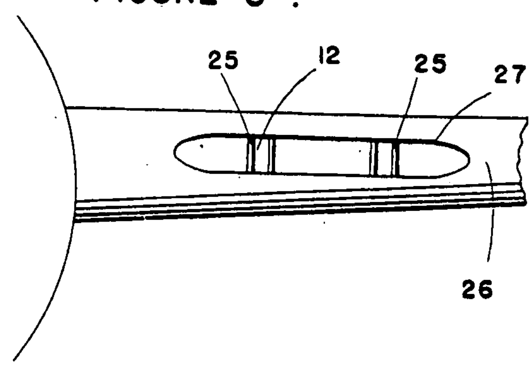


FIGURE 5 .



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2,581,047

PIPE COUPLING

Alexander H. Salmond and Thomas Denluck, Victoria, British Columbia, Canada

Application September 24, 1949, Serial No. 117,561
In Canada July 29, 1949

1 Claim. (Cl. 285—123)

1

This invention relates to a pipe coupl'ng, and the ob'ects of which are to provide a joint, or pipe connector in two parts, each of which part is semi-spherical as regards its main portion and extends integrally as a tubular pipe connecting po tion for the passage of fluids through the coupling, which latter portions are threaded for the reception of pipes or rods if the coupling is being used as a rod connector for which it is also well adapted, an external union is provided to connect the two portions together.

An advantage in our invention is that the two parts of the coupling may be adjusted to any relative angularity to provide for the joining of two pipes or rods, the axial alignment of which are not coincident, and that there is no limitation to the degree of obtuse angularity between the axes of the pipes or rods to be connected ranging from 90 degrees to a perfectly straight axial coincidence, which angular adjustment is a considerable advantage in such connections around corners.

A further advantage is that there is no obstruction in the passageway through the joint which could so readily cause clogging to stop the flow therethrough.

A still further advantage is that the connection of the two parts is a very simple matter, when the two hemispherical elements are brought together and the union turned to provide a leakproof pipe fitting, or a thoroughly efficient rod connection.

With our invention a wider range of connection adjustments is evident than in conventional so called universal couplings, and eliminates elbows and pipe bending, and an essential improvement is that the passageway is open throughout the length of the coupling due to the absence of the usual internal cap-screw or pivot bolt for connecting the two semi-spherical or similar conventionally shaped parts together, which parts may similarly be termed hemispheroids.

There are no internal springs or nuts in our invention, the tightening of the joint or coupling being accomplished by merely turning an exterior union member to bring the contacting faces tightly together.

With these objects and advantages in view this invention consists in the novel features of construction hereinafter described and claimed, and in the drawings accompanying this specification it must be observed that similar numerals refer to similar parts throughout the different views.

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Fig. 1 is a view of the complete coupling for joining two straight-in-line pipes together.

Fig. 2 is a view showing the two coupling parts apart.

Fig. 3 is a view of the coupling as used for a 90 degree connection.

Fig. 4 is a part sectionalized view showing the angular adjustability of the coupling.

Fig. 5 is a view of the union in section used for connecting the two elements of the coupling together.

With reference to the drawings the numeral 1 indicates one semi-spherical part of this pipe coupling, and the numeral 1a refers to the other semi-spherical part thereof, each of which part is chambered as indicated at 2 and 2a respectively. Each said part has a tubular extension socket 3 and 3a respectively, and integral therewith, which may be threaded as indicated in Figure 3, and each said separate part communicates with its chambered part mentioned. Thus there is a clear passageway for fluid through this coupling without any kind of obstruction, which is the main object of this invention.

The two portions of the coupling are illustrated as separated in Fig. 2, to demonstrate their connection features. One part 1 is externally threaded circumferentially as at 4 and is formed with an annular rib 5 of large internal diameter compared with that of the extension members 3 and 3a. This rib 5 fits into a circular flange or shoulder 6 of the coupling member 1a to contact the flat annular face 7 of the member 1 from which the rib 5 extends. A gasket could be advantageously inserted between these two flat faces.

The coupling of the two parts in this joint is done by means of an internally threaded union 8 which screws on the threads 4, and would be secured by a wrench. The member 1a is provided with a circular flange 9 projecting outwardly from the outer circumference thereof, over which flange a circular clamping rim 10 of the union fits so that the two half parts of the coupling may be drawn together tightly as a connected unit when the union is screwably turned.

There are recesses 11 in the extension members 3 and 3a which permit a minimum sized union being used so that the coupling will appear as compact and neat in shape as possible.

Whereas the terms semi-spherical and hemispherical, and their relative equivalents, have been used herein, in the specification and claim,

Jan. 1, 1952 A. H. SALMOND ET AL 2,581,047

PIPE COUPLING

Filed Sept. 24, 1949

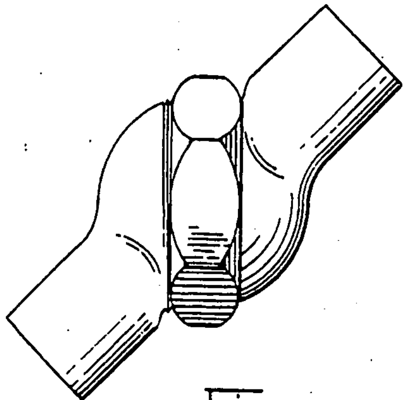

Fig.1

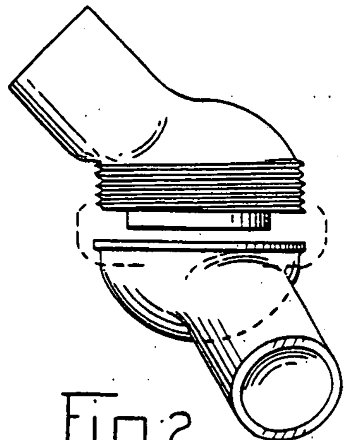

Fig.2

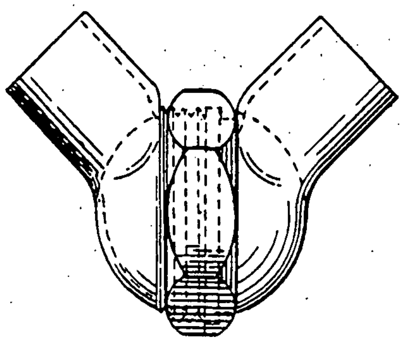

Fig.3

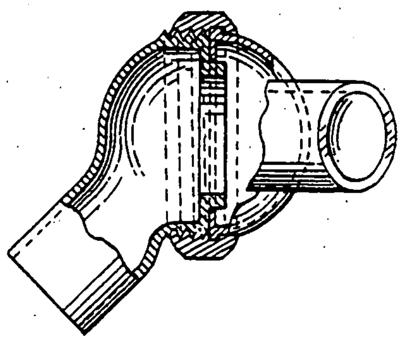

Fig.4

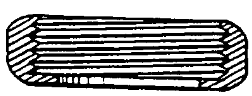

Fig.5

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it is to be understood that such terms refer to the same things, which equivalency applies also to the term collar as the same thing as a union, as used herein.

What we claim and for which we desire Letters Patent is:

A pipe coupling comprising in combination a pair of substantially similar mating components consisting of a hemispheroid, a socket projecting from the exterior side of the hemispherical surface thereof, the axis of said socket being radially disposed in relation to said hemispheroid, said axis lying at or about 45 degrees from the produced plane of the perimeter of said hemispheroid, one of said hemispheroids being externally and perimentrically screw-threaded, the other being provided with an externally projecting, perimetrical flange, an inwardly projecting perimetrical flange on the hemispheroid containing said outwardly projecting flange, an annular inwardly projecting and perimetrical rib of right-angular cross-section of the hemispheroid which is screw-threaded, said inwardly projecting flange fitting into the interior angle formed by said rib cross-section, and abutting said rib, and an annular, internally screw-threaded collar or union for uniting said hemispheroids.

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THOMAS DENLUCK.

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Patented Feb. 26, 1952

2,586,942

UNITED STATES PATENT OFFICE

2,586,942

APPARATUS FOR PREVENTING BACKFLOW OF LIQUID

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Application November 8, 1947, Serial No. 784,837

4 Claims. (Cl. 137—78)

1

This invention relates generally to apparatus for the purpose of preventing back flow of water from service or consumer piping to water supply mains.

Various types of apparatus have been used in conjunction with water supply systems for the purpose of preventing objectionable water contamination due to back flow of contaminated water for consumer piping to the water supply mains. One of the simplest types of apparatus to prevent such back flow consists of a check valve which opens to permit normal flow of water, and which closes in the event the consumer pressure equals or becomes greater than the supply pressure. In conjunction with such a check valve a vacuum breaker valve may also be connected to the inlet side of the same, thus serving to prevent sucking of contaminated water through the check valve due to a temporary subatmospheric pressure in the supply main.

With all of the more common types of check valves there is always some danger of leakage sufficient to cause serious contamination, due for example to an obstruction or mechanical failure which prevents proper closure. Therefore more elaborate apparatus which affords utmost safety makes use of two check valves connected in series between the water supply mains and the consumer piping in conjunction with an automatic unloading valve serving under certain conditions to vent the space between the check valves to the atmosphere. As usually installed and adjusted the unloading valve has fluid connections to both the space between the check valves and the water supply main, and serves to vent the space between the check valves to the atmosphere when the pressure in said space attains a value substantially equal to the inlet or water supply main pressure. With such apparatus it is assumed that no contamination of the water main can occur because the pressure upon the outlet side of the first check valve can in no event exceed the water main pressure.

Back flow preventing apparatus of the type last described has incorporated common types of check valves, which generally utilize rigid disc or flap valve members adapted to seal upon a stationary annular seat. When such a check valve is closed pressure variations upon the outlet side cannot be transmitted to the inlet side because the valve member and associated parts form in effect a rigid barrier between the inlet and outlet. Therefore an abnormal back pressure in the service or consumer piping cannot be transmitted to the space between said valves, during periods when no flow is occuring through the valves. In other words operation of the unloading valve can occur only when back flow leakage takes place through the second check valve. I have found that this reliance upon leakage is a distinct disadvantage, because it necessarily requires flow of contaminated water into the space between the check valves, and in addition it makes it necessary for the unloading operation to lag behind in attainment of abnormal pressure in the service or consumer piping, thus failing to afford the fullest amount of protection against back flow contamination.

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It is an object of the present invention to provide apparatus for preventing back flow of water from water supply mains to service piping, making use of two check valves in conjunction with an automatic unloading valve as described above, but which will have the feature of causing unloading of the space between the check valves when an abnormal pressure condition occurs, without the necessity of leakage through the second check valve.

Another object of the invention is to provide apparatus of the above character which will afford improved protection against back flow contamination, and which will be highly reliable in its unloading operation.

Additional objects of the invention will appear from the following description in which the preferred embodiment has been set forth in detail in conjunction with the accompanying drawing.

Referring to the drawing:

Figure 1 is a side elevational view showing apparatus incorporating the invention.

Figure 2 is a plan view partly in section showing the two check valves and the unloading valve.

Figure 3 is a cross-sectional view taken along the line 3—3 of Figure 1.

Figure 4 is a cross-sectional view taken along the line 4—4 of Figure 1.

The apparatus illustrated in the drawings consists generally of a pair of serially connected check valves 11 and 12, in conjunction with an automatic venting or unloading valve 13. In actual commercial installations it is desirable to provide a hand operated valve 14 between the check valve 11 and the water supply piping 16. Likewise a hand operated valve 17 is connected between check valve 12 and the service or consumer piping 18. In a typical instance the pipe 16 is connected with service piping of an industrial plant, and the water carried by the same may be exposed to serious contamination. The purpose of my apparatus is to provide against back flow of such contaminated water from the pipe 18 to the pipe 16.

In place of utilizing check valves of conventional construction, I utilize valves of the type making use of a rubber sleeve having one end edge of the same adapted to seal upon a circular barrier. Thus the valves illustrated make use of three body parts 21, 22 and 23, which are coupled together by suitable means such as bolts 24 and 26. The inlet passage 27 formed by body

part 21 is connected directly with the piping 16 through the hand valve 14, and the outlet passage 28 formed by body part 23 is directly connected with the piping 18 through hand valve 17. The connecting space 29 between the two check valves is formed by body part 22 and it is normally closed, except under certain pressure conditions as will be presently explained.

Mounted within the body part 22 there is an annular core 32 which is provided with an annular seat surface 33. The periphery of core 32 on the inlet side of sealing surface 33 is provided with spaced longitudinal ribs 34, which mount the annular support ring 36, and the positioning lugs 37. The lugs 37 are received within the annular recess 38 formed in the body part 21. The outlet end of the core 32 is engaged by the lugs 39, which are carried by the body part 22.

Surrounding the core 32 there is a resilient rubber sleeve 41 which has one end of the same provided with a flange 42, for enabling the same to be gripped between the two adjacent body parts. It is desirable that this rubber sleeve be made tapered as illustrated. Thus it is formed to provide a relatively thin wall portion 41a which is adapted to seal upon the surface 33, a relatively thick wall portion 41b which extends from the flange 42, and a tapered wall portion 41c which joins the relatively thin wall portion 41a with the thick wall portion 41b.

Normally when the resilient sleeve is not being acted upon by substantial differential pressure, the relatively thin wall portion 41a assumes a contracted position in sealing engagement with the annular surface 33. However, with application of substantial pressure to the inlet side of the check valve, the sleeve is expanded outwardly from the sealing surface 33, thus permitting flow of liquid. The differential pressure required to open this type of check valve is dependent in part upon the resiliency of the wall portion 41a. For the check valve 11 the rubber sleeve is selected to require a substantial differential pressure to open the same, as for example of the order of 3 to 4 p. s. i. However, for the check valve 12 the rubber sleeve is selected whereby the differential pressure required to open the same will be negligible, as for example of the order of from 0.3 to 0.5 p. s. i.

The working parts of the check valve 12 are substantially the same as for the check valve 11. The core 46, sealing surface 47, ribs 48, annular ring 49 and mounting tabs 51 can be substantially the same as the corresponding parts for check valve 11. The resilient rubber sleeve 52 likewise is constructed with a relatively thin wall portion 52a, a thick wall portion 52b and a tapered wall portion 52c. Because check valve 12 is arranged to open with negligible applied differential pressure, the wall portion 52a is relatively thin compared to wall portion 41a for the check valve 11.

The unloading or venting valve 13 can vary in specific design but should be constructed and operated in such a manner as to vent the space 29 when the pressure in this space reaches a value substantially equal to the pressure in the inlet passage 27, as for example within 0.5 p. s. i. of the inlet pressure. The particular unloading valve illustrated is provided with a fluid pressure operated diaphragm, and the chambers on opposite sides of the diaphragm are connected respectively with the inlet passage 27, and the intervening space 29.

To more specifically describe the unloading valve illustrated, a pair of valve members 56 and 57 are carried by the movable valve stem 58 and are adapted to close upon the seats 59 and 61 carried by the valve body 62. A pipe 63 connects the inlet side of this valve body to the space 29. The discharge passage 64 may connect to the atmosphere or to a convenient sewer.

The valve stem 58 is attached to a fluid pressure operated diaphragm 66 which is carried by the diaphragm mounting 67. Space 68 on one side of this diaphragm is connected by pipe 69 to the inlet passage 27. The space 71 upon the other side of the diaphragm is connected by pipe 72 with the space 29 intervening between the two check valves. A light compression spring 72 normally urges the valves 56 and 57 toward open position. The relationship between the fluid pressure areas on opposite sides of the diaphragm, in conjunction with the compression spring 72, is such that the valve members 56 and 57 remain closed when the pressure in inlet 27 is substantially greater than the pressure in space 29. However, if under abnormal conditions the pressure in space 29 should attain a value substantially equal to the pressure in inlet 27, then diaphragm 66 causes movement of the same to unseat the valve members 56 and 57, and thus permit venting or unloading of liquid in space 29.

In addition to the parts described above it is desirable to provide a so-called vacuum breaker valve in communication with the space 27. As illustrated in Figure 4, such a valve 76 can be a check valve constructed substantially the same as the check valves previously described. Thus the valve 76 includes a body 77 which is connected to the body part 21, an inner core 78, and a resilient sleeve 79 which normally seals upon the core 78. Subatmospheric pressure in space 29 causes the check valve 76 to open to the atmosphere.

Each of the check valves 11 and 12 has a peculiar characteristic not possessed by conventional types of check valves, such as are provided with a flap or like valve member closing upon a stationary annular seat. Considering the check valve 11, a substantial area of the rubber sleeve 41 forms in effect a flexible diaphragm which is interposed between the inlet and outlet passages. Assuming that some back pressure is applied after closure, the rubber tube is contracted inwardly to a smaller diameter, thus in effect increasing the outlet volume and decreasing the volume on the inlet side. The same is likewise true of the check valve 12. As will be presently explained this characteristic plays an important part in the mode of operation.

To describe the mode of operation of the apparatus, it will be presumed that it is connected substantially as illustrated in Figure 1 with both the manual valves 14 and 17 open, and with pipe 18 representing consumer piping such as may be employed in an industrial plant. In a typical instance the normal water main pressure may vary from say 60 to 90 p. s. i. Under all normal flow conditions a predetermined differential is maintained across the check valve 11, as for example a differential of the order of 3 or 4 p. s. i. As previously explained this differential is maintained because of the pressure required to expand the rubber tube 41. Assuming a reasonable rate of consumption from the service or consumer piping 18, both of the check valves will be held open by flow of liquid, and the unloading valve 13 will remain closed by virtue of the differential between the pressures applied to the diaphragm

66. Under abnormal conditions the pressure in the outlet passage 28 may equal or even exceed the inlet pressure applied to passage 27. As the pressure value in passage 28 approaches that in passage 27, both of the check valves 11 and 12 tend to close, and when the pressure in outlet 28 substantially equals the pressure in inlet 27, pressure is transmitted through the flexible sleeve 52 to the liquid in space 29, thus causing the pressure in space 29 to be substantially the same value. Application of such pressure from space 29 to the diaphragm 66 causes this diaphragm to move to open the valves 56 and 57, thus connecting space 29 to the atmosphere. If this condition should occur at a time when there is substantial pressure in the inlet 27, and if there is no back flow leakage past check valve 12, the differential pressure across check valve 11 will immediately be increased whereby unloading valve 13 immediately closes. Assuming that back pressure is applied from outlet 28 to a value equal to or greater than the pressure applied to inlet 27 and that there is improper closing of the check valve 12, abnormal pressure in the outlet 28 causes back leakage past the check valve 12, thus serving to maintain a pressure in space 29 at a value equal to the pressure in inlet 27. Under such conditions the unloading valve 13, after initial opening of the same, remains open to continuously vent such leakage from space 29. Thus back flow leakage past the check valve 12 can in no event reach the inlet 27.

If a temporary condition should occur in which no water is being consumed from the pipe 18, and the pressure applied to inlet 27 drops from normal by a margin slightly greater than the differential normally maintained across the check valve 11, the rubber tube 41 tends to collapse upon its core due to back flow pressure applied to the same. As a result the volume of space 29 is increased and the pressure in this space is relieved and caused to assume a value substantially less than that in the inlet. Therefore the unloading valve 13 is not affected, which is desirable because such a condition is not dangerous and does not threaten water contamination. Under like conditions using apparatus having check valves of conventional construction, the unloading valve would be subject to temporary false operation.

It will be evident from the foregoing that my apparatus not only provides for operation of the unloading valve during abnormal back pressure conditions when the second check valve fails to close properly, but in addition it connects the space between the check valves to the atmosphere under certain unsafe abnormal back pressure conditions, irrespective of actual leakage through the second check valve.

I claim:

1. In valve apparatus for preventing back flow of water from consumer piping to water supply piping, a first check valve having its inlet connected to the supply piping, said check valve requiring application of a substantial pressure differential to effect opening of the same, a second check valve having its inlet connected to the outlet of the first check valve and having its outlet connected to consumer piping, said second valve including a flexible diaphragm-like valve member interposed between the inlet and outlet passages of the same when the valve is closed and capable of substantial deflection after the valve is closed, an unloading valve movable between open and closed positions and connected to the space between said check valves, and means serving to operate said unloading valve responsive to a condition in which the pressure in said space attains a value substantially equal to the supply pressure, said flexible valve member of the second valve being capable of deflection to transmit back pressure in the consumer piping to the space between the check valves to thereby cause operation of the unloading valve.

2. In valve apparatus for preventing back flow of water from consumer piping to water supply piping, a first check valve having its inlet connected to the supply piping, said valve requiring a substantial predetermined differential pressure to open the same, a second check valve having its inlet connected to the outlet of the first check valve and its outlet connected to the consumer piping, said second valve including a flexible diaphragm-like member interposed between the inlet and outlet passages of the same when the valve is closed and serving when flexed to vary the volume of the space between the check valves, and valve means for effecting automatic venting of said space, said valve means having fluid connections with both said space and the water supply piping and operative to vent said space when the pressure in said space attains a value substantially equal to the pressure of the water supply, said flexible valve member of the second valve being capable of deflection to transmit back pressure in the consumer piping to the space between the check valves to thereby cause operation of the unloading valve.

3. A valve apparatus for preventing back flow of water from consumer piping to water supply piping, a first check valve having its inlet connected to the supply piping, said check valve requiring application of a substantial pressure differential to effect opening of the same, a second check valve having its inlet connected to the outlet of the first check valve and its outlet connected to the service piping, there being a closed space formed between said check valves, each of said check valves including a flexible diaphragm-like valve member interposed between the inlet and outlet passages of the same when the valve is closed and capable of flexing movement to vary the volumes of the spaces on opposite sides of the same, and unloading valve means connected to said closed space and having operative fluid connections to both said space and to the inlet side of the first check valve, said venting means serving to vent said space responsive to a pressure value in said space substantially equal to the pressure applied to the inlet of the first check valve, said flexible valve member of the second valve being capable of deflection to transmit back pressure in the consumer piping to the space between the check valves to thereby cause operation of the unloading valve.

4. A valve as set forth in claim 3, in which each of the check valves includes a resilient rubber tube forming said flexible diaphragm like member.

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APPARATUS FOR PREVENTING BACKFLOW OF LIQUID

Filed Nov. 8, 1947

3 Sheets-Sheet 1

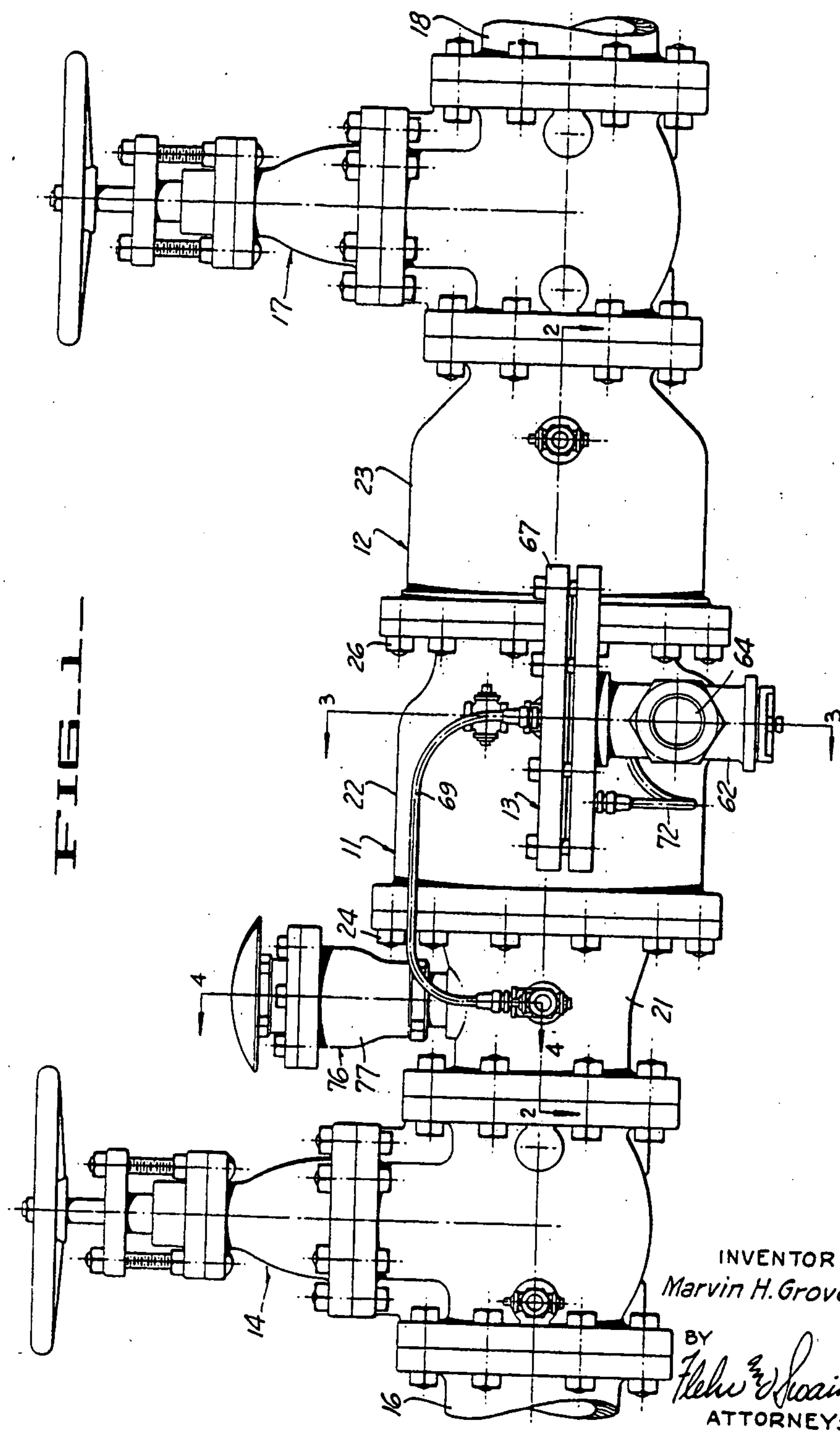

FIG. 1

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Feb. 26, 1952 M. H. GROVE 2,586,942

APPARATUS FOR PREVENTING BACKFLOW OF LIQUID

Filed Nov. 8, 1947

3 Sheets-Sheet 2

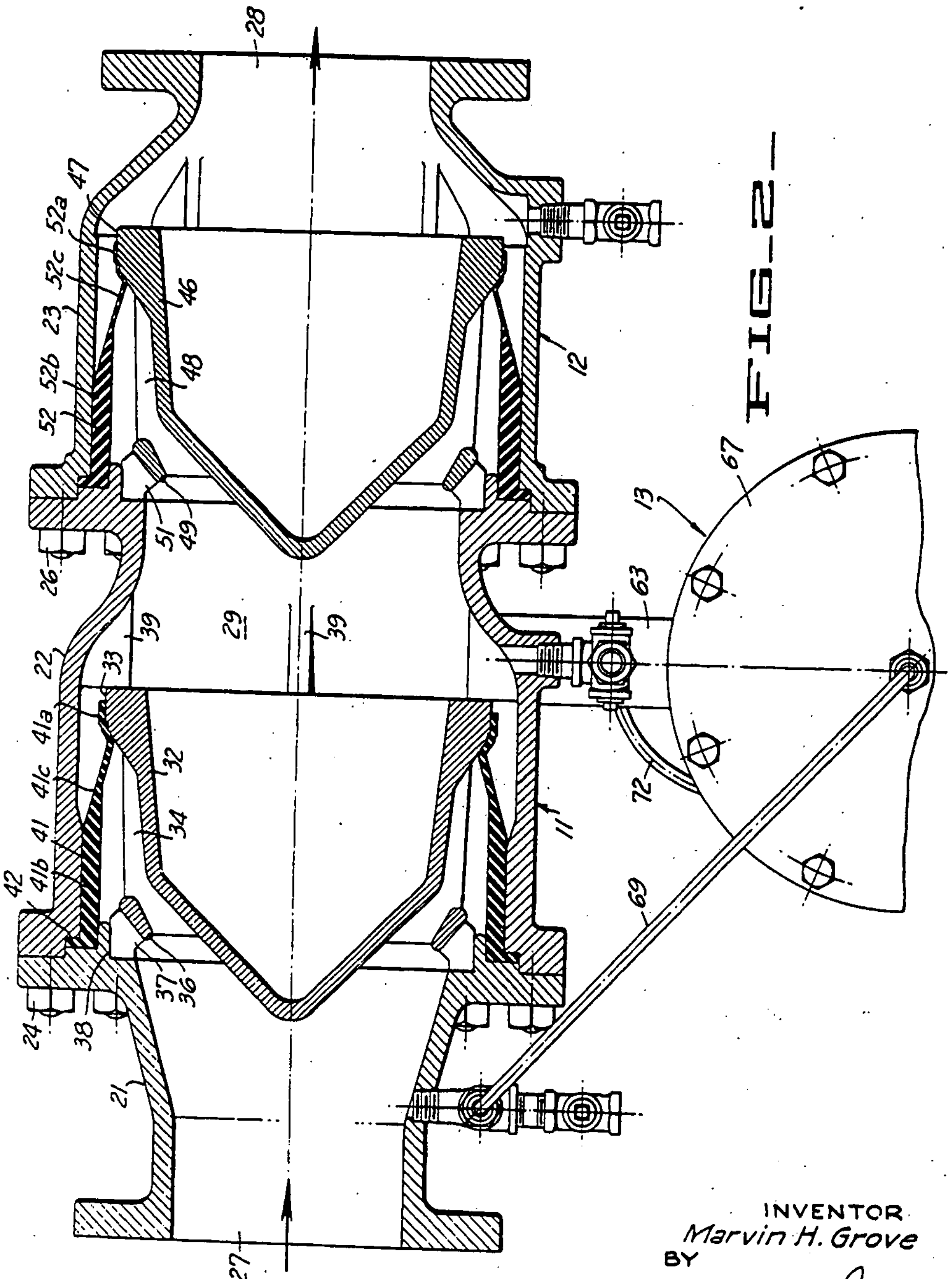

FIG_2_

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Feb. 26, 1952   M. H. GROVE   2,586,942

APPARATUS FOR PREVENTING BACKFLOW OF LIQUID

Filed Nov. 8, 1947

3 Sheets-Sheet 3

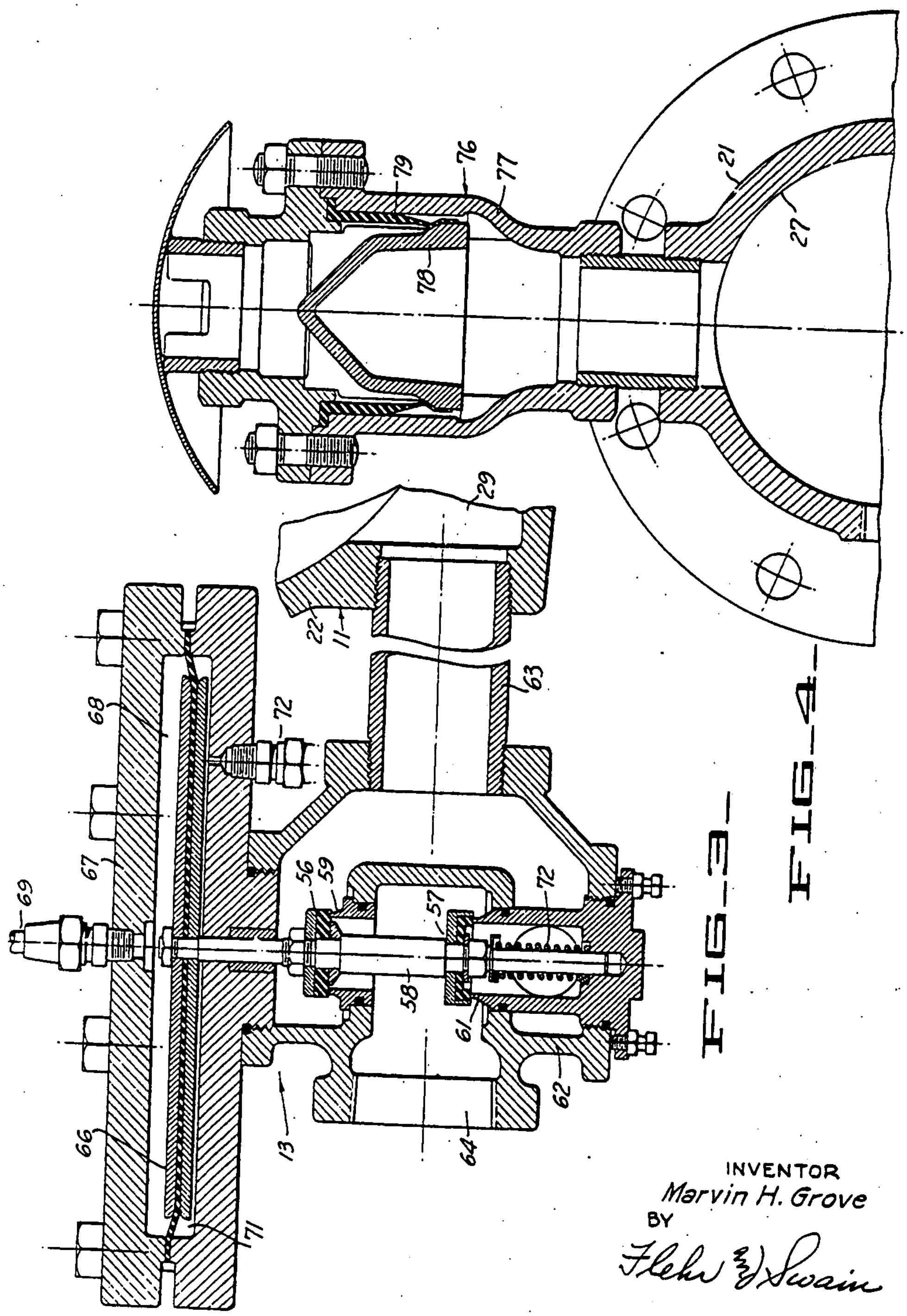

FIG_3

FIG_4

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United States Patent Office

2,827,921

Patented Mar. 25, 1958

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2,827,921

LOW TORQUE INSTANT CLOSING CHECK VALVE

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5 Claims. (Cl. 137—527)

This invention relates to check and foot valves generally and, in particular, to a check or foot valve that has a toggle joint closure mechanism that will offer a minimum of resistance to fluid flow through the valve, yet which will act positively to close the valve just before a column of liquid moving through the valve can stop and reverse its direction of flow.

It is customary in the transportation of liquids to use both check and foot valves to seal off a head of liquid within the system so that the column will be retained and not lost by drainage when movement of the liquid ceases. A familiar example is the use of either a check or foot valve to hold a column of liquid within a pump by sealing off the pump's discharge or intake ends, respectively, so that the pump remains primed during periods of non-use. In such use it is particularly important that the foot or check valve provide an absolute seal so that there is no liquid drainage or leakage of air which will destroy the priming, particularly if the valve is to be used in connection with a primer, such as an exhaust or suction primer.

A particular defect of conventional check and foot valves of both the "swing" and "ball" check types is a failure to provide an adequate leak-tight seal sufficient to prevent leakage or loss of suction. In an effort to overcome this defect, various valve structures have been employed to provide a better seal, in most cases including a spring load on the valve, urging it firmly into contact with the valve seat. However, regardless of the particular manner in which the positive closing pressure is applied, each of these prior art valves has in common the defect of an excessive friction drag or pressure drop across the valve during operation. Such a pressure drop occurs as a result of the resistance to flow created by the spring load or other pressure-applying means used to tightly seal the valve, which must be overcome by the moving column of liquid in order to maintain the valve in an open position. As a result, additional horsepower must be developed by the pump, solely for the purpose of holding the valve open, at a considerable loss in economy.

A further disadvantage of most prior art check and foot valves is the lack of any completely adequate protection against sudden or quick closing of the valve. This is particularly true of the standard "swing" check valve which is not spring loaded. It frequently occurs that such valves will get rusty and tend to stick in an open position so that a considerable reverse velocity of the water column will develop before the valve will close. When the valve does close, it is apt to do so with a tremendous slam, creating a "water hammer" effect. This effect occurs because the kinetic energy of the moving water column cannot be absorbed, since the liquid is nearly incompressible, and therefore appears as an instantaneous shock which may be of sufficient intensity to injure pipe, fittings, or the pump.

The present invention is directed to a solution of the above and many additional problems, as will appear, and one object of the invention is to provide a unitary, spring-

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loaded check-and-foot valve structure that not only insures a positive valve-closing action providing an absolute leak-tight seal, but which also prevents excessive pressure drops across the valve during operation without endangering the sysetm through retarded or faulty valve action.

Another object of the present invention is to provide a check and foot valve with a spring-loaded toggle action that will act to close the valve just prior to any reversal of fluid flow through the valve so that the danger of water hammer resulting from the valve action will be virtually eliminated.

Another object of the invention is to provide a valve-closing toggle linkage which operates by pressure applied on a knee joint of the linkage to multiply the closing pressure on the valve in its closed position, but which also operates by a reverse linkage to substantially reduce the pressure, tending to close the valve in an open position so that a minimum of pressure is required to maintain the valve in its open position.

Another object is to provide a toggle linkage that will assume a relatively flat obtuse angle in the closed position of the valve where a minimum spring load is required to maintain a leak-tight valve seal, and which will assume a relatively pointed acute angle in the valve open position and yet the increased spring load will not produce a valve-closing force as great as that produced by the spring in the closed position of the valve.

Another object of the invention is to provide a spring-loaded toggle means for closing a check or foot valve that will act to produce a maximum valve-closing force in a closed-valve position with diminishing valve-closing forces resulting as the valve is moved to an open position. As a result, the valve action will produce the dual advantages of a minimum pressure drop across the valve while open, and a safe, slow-starting but gradually accelerating valve-closing action when the flow slows down.

Other objects and advantages of the present invention will appear from the following description and from the drawings in which:

Fig. 1 is a view in perspective of a check-and-foot-valve construction according to the present invention, showing the valve in its closed position and with portions of the valve body broken away for the sake of clarity;

Fig. 2 is a view in vertical section of the device of Fig. 1, along the line 2—2 of Fig. 3, likewise showing the valve in its closed position;

Fig. 3 is a view in vertical section along the line 3—3 of Fig. 2;

Fig. 4 is a like view showing a fully-open position of the valve;

Fig. 5 is a diagrammatic view, corresponding to the closed-valve position of Figs. 1–3, showing the spring pressure applied to the valve-closure mechanism in relation to the closing pressures actually imparted to the valve itself; and

Fig. 6 is a like view, corresponding to the fully-open position of Fig. 4, likewise showing the relation between spring and valve closing pressures.

In a broad view the present invention includes a valve body A having a valve seat B; a valve or clapper C adapted to engage the valve seat in leak-tight fashion; a hinge blade member D mounting the valve for movement between open and closed positions relative to the valve seat; and a spring-loaded toggle means E including links F, F' and springs G. In its general operation the toggle linkage E exerts a closing pressure on the valve C through the action of the springs G, tending to straighten out the linkage. Because of the unique arrangement of parts, the angles formed between the links F, F' in various valve positions are such that the closing pressure exerted by the springs G is multiplied by the linkage when the valve is in a closed position, but, by a reverse linkage, is

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Fig. 5.

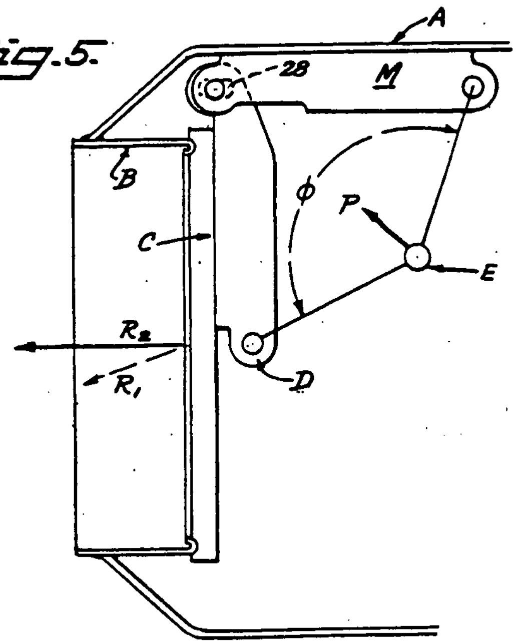

Fig. 6.

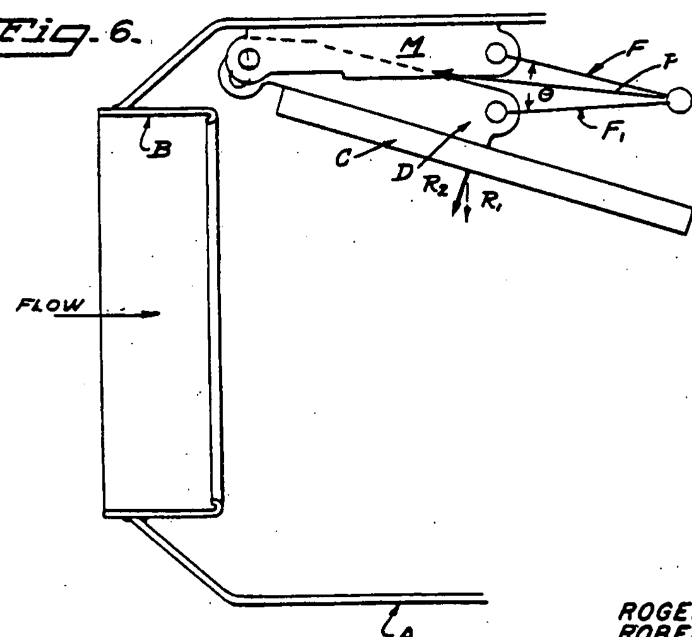

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Fig. 3.

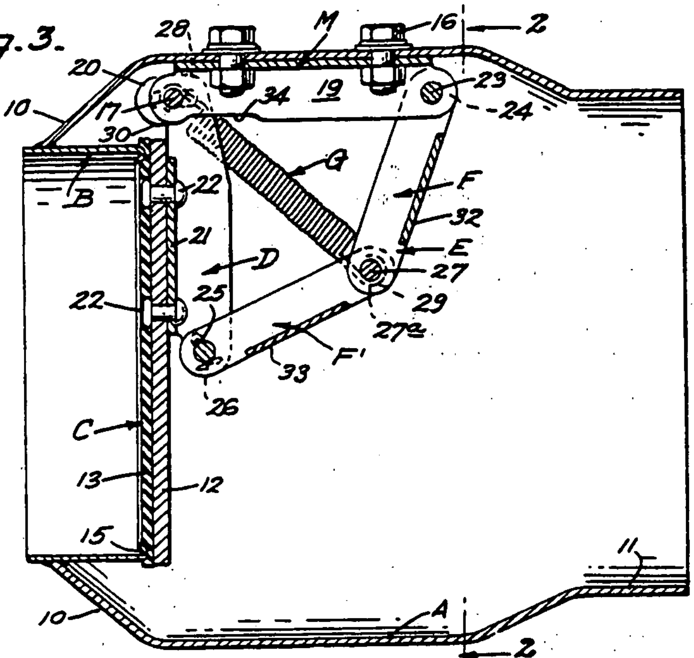

Fig. 4.

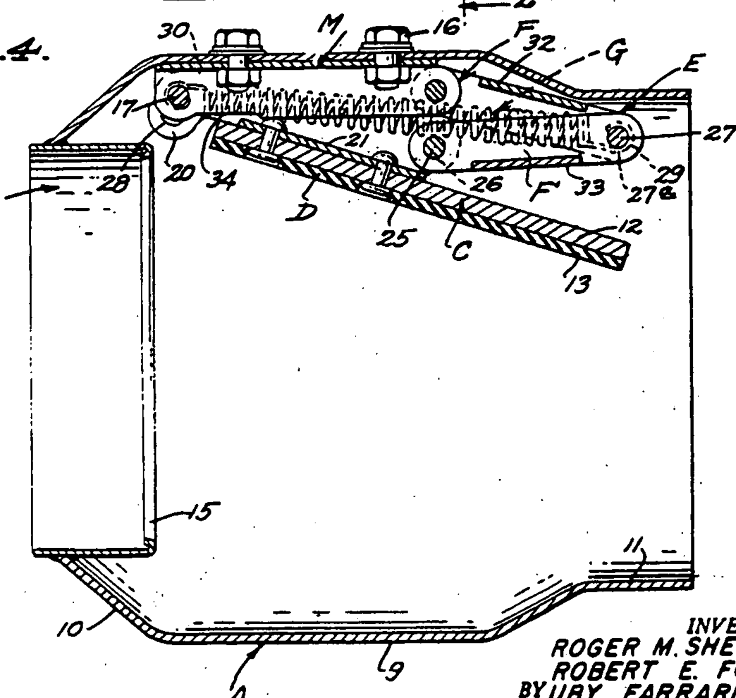

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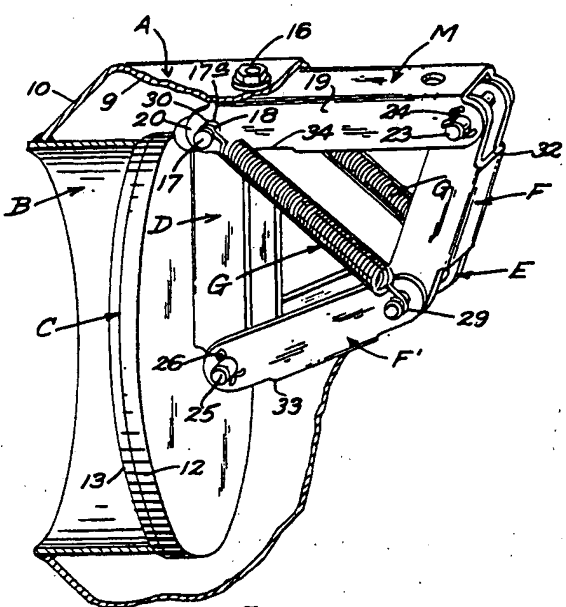
Fig. 1.



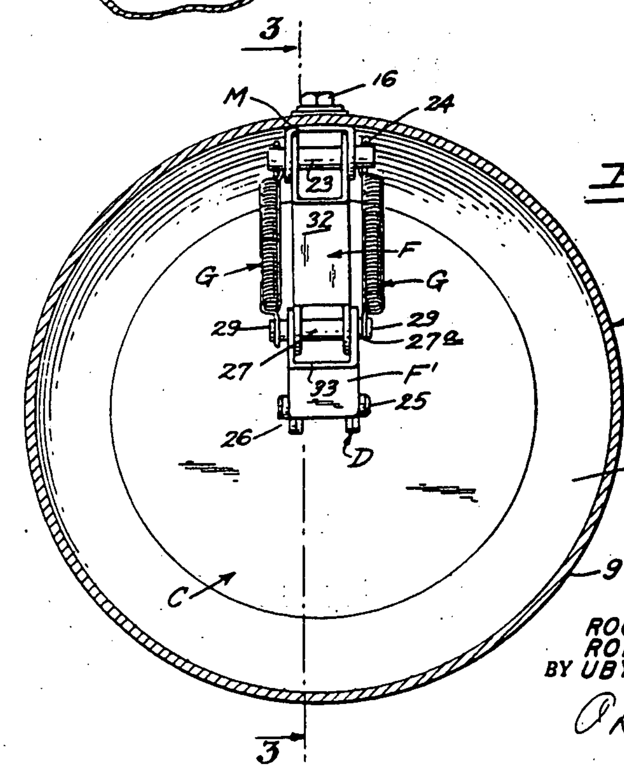


Fig. 2.

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diminished when the valve is in an open position, as will be more fully explained below. As a result, a more efficient valve is produced since the pressure drop or horsepower loss involved in keeping the valve open is reduced to a minimum and the force of the springs is multiplied as the flow slows down so that the valve will be brought quickly to its closed sealed position.

Referring to the drawings in detail, A indicates a valve body which may include a generally cylindrical shell portion **9** tapering to reduced end portions **10** and **11** adapted for welding to suitable couplings which are not shown. Rigidly secured in the end **10**, as by welding, is the valve seat B which extends inwardly into the valve body A. Preferably, the valve seat is provided with an annular, curled flange **15** on its inner edge. Adapted to engage the flange **15** of the valve seat B in a sealing relation is the valve or clapper C. The valve C may take any conventional form, but is illustrated as a circular metal disc **12** faced by a sealing disc **13** which may be fabricated of a suitable, resilient, compressible material, such as rubber, so that a leak-tight seal will be provided when the valve A is pressed firmly into contact with the valve seat B.

Rigidly secured to the shell **9** of the valve body, by cap screws **16**, is the mounting channel M. The hinge blade member D is pivotally supported from the channel M by a hinge pin **17** extending outwardly through circular bearing holes **18** in the sides **19** of the mounting channel M. Preferably the hinge blade D is also channel-shaped and has elongated perforations in its ears **20** through which pass the extending ends of the hinge pin **17**. Annular grooves **17a** near the ends of the pin **17** receive the looped ends **30** of the springs G and hold the pin **17** in place. The elongated perforations **28** in the blade D allow the valve clapper C to seat itself evenly on the valve seat **15** under influence of the pressure applied by the toggle linkage E.

The valve C is rigidly secured to a cross portion **21** of hinge D, as by rivets **22**, and, consequently, moves with the hinge member D to open and closed positions of the valve C relative to the valve seat B, as will be described.

It will be clear that the structure just described constitutes within itself a check or foot valve permitting flow in one direction, but preventing flow in the opposite direction. This flow is from left to right as viewed in Figs. 3 to 6 of the drawings. However, a particular advantage of the present invention resides in the unique valve-closing action provided by the toggle linkage E. This linkage is provided by the links F, F′ and the spiral coil springs G. Each of the links F, F′ is a channel member having elongated sides apertured at both ends. The upper link F is supported by a pin **23** extending through apertures in the mounting bracket M. Endwise movement of the pin **23** may be prevented by cotter pins **24** in a well-known manner. The lower link F′ is pivotally secured to the hinged valve structure by a pin **25** supported in the lower end of the hinge member D. Cotter pins **26** may also be provided in the ends of the pin **25**, as before. The two links F, F′ are pivotally connected at a common joint provided by a knee pin **27**, secured against endwise movement by the ends of the springs which engage in annular grooves **27a** cut near the ends of the pin **27**. Pressure is applied to the knee joint **27** by means of the expanded springs G.

Figs. 3 and 5 illustrate the operation of the toggle mechanism E when the valve is in a closed position. As shown, the links F, F′ form a relatively flat obtuse angle ϕ. As a result a comparatively small force effectively applied at the common joint **27** and acting in a direction tending to straighten out the links is capable of exerting a large pressure at the moving end. which in the present application is the end secured to the valve clapper. This feature is diagrammatically illustrated in Fig. 5 where the relatively small pressure exerted by the springs G is represented by the letter P, while the resulting much

larger pressure exerted by the toggle linkage E is represented by R_1, while R_2 represents the ultimate closing pressure exerted on the valve clapper C. Due to this multiplication of pressures, the valve C is firmly urged against the valve seat B and through compression of the rubber valve face **13** a gasketing effect is achieved that insures an absolutely leak-tight seal.

The operation of the toggle linkage E in an open position of the valve is illustrated in Figs. 4 and 6. In this position the valve has been pushed open and is being held open by liquid flow through the valve, indicated by the flow arrow at the left of **6**. As a result, the toggle linkage E has assumed the relatively pointed acute angle designated by θ. However, by a reverse linkage inherent in the toggle action, a comparatively large pressure in a direction tending to straighten out the linkage will produce only a relatively small pressure at the moving end of the linkage secured to the valve clapper C. This principle is diagrammatically illustrated in Fig. 6 where the increased pressure P exerted by the springs G, under considerable expansion, produces only a small resulting force R_1 which produces an even smaller valve closing pressure R_2. The ultimate effect of this reverse linkage is a relatively small pressure loss across the valve due to so much less energy being required to hold the valve open as compared to that required in the first instance to swing it open. This feature is particularly important in forced circulation system utilizing the pump, since only a relatively small portion of the pump's energy must be diverted to the task of holding the valve open once it is opened. This results in achieving a maximum pumping efficiency in the line. It also gives another important operating characteristic, namely, that as soon as the fluid flow has almost ceased, the clapper C will immediately begin to close and, while there is still a slight flow, the clapper C will close on its seat **15**. This assures that a full column of fluid will be trapped in the pipe and, more important, it prevents any possibility of water hammer. Also, portions of the sides **19** of the mounting bracket M may be cut away, as at **34**, to facilitate a free, full opening movement of the valve C.

The overall operation of the valve will now be described. In foot valve applications the valve will be positioned at the intake side of a suction line or under the surface of the liquid to be pumped. Consequently, when the pump is put in operation, the suction created within the valve body will cause liquid pressure to be exerted on the face of the valve C against the pressure exerted by the toggle closing mechanism E. This pressure will ultimately force the valve into the full open position of Figs. 4 and 6.

When the valve has been pushed to a point where the angle between the links F, F′ becomes somewhat less than 90°, the reverse linkage effect will begin to decrease the closing pressure being applied to the valve C by the springs G until in the full open position of Figs. 4 and 6 the spring pressure is at its minimum so that the valve C will exert a relatively small retarding force on the flow of liquid through the valve. As a result, the flow through the valve during its operation is substantially unrestricted so that there is a minimum pressure loss in maintaining the valve in an open position, and yet the valve will be instant in closing upon stoppage in flow.

When the pump is stopped, the gentle closing pressure exerted on the valve in its open position begins to take effect. This closing pressure quickly but gradually increases with the increasing angle between the links F, F′ until, finally, the tightly-closed valve position of Figs. 3 and 5 is reached. The valve action thus produced will cause the valve C to close just prior to a stopping and reversal of fluid flow which would otherwise occur, thereby providing a smooth, even, non-slam valve-closing action. In this way the effects of a faulty or retarding valve-closing action, such as a water hammer, are prevented and the valve traps a full column of fluid in the pipe.

In check valve applications, the valve structure would be positioned on the discharge side of the pump with the valve normally in a closed position when the pump is not in operation. This would assure maintenance of a column of water to hold the prime in the pump. When the pump is started, water pressure is created on the left or face side of the valve C, as before, with a similar valve action occurring as the valve is pushed by the flow of water to the open position of Figs. 4 and 6. When the pump is shut off, the diminishing water flow through the valve permits the valve-closing pressure exerted by the toggle linkage E to take effect in similar fashion to the valve-closing action just described in connection with its use as a foot valve. Thus it will be clear that the unique valve action provided by the toggle action E is particularly adaptable to either check or foot valve applications and in each case will result in an even, positive, non-slam valve action which will not only provide an absolutely leak-tight seal, but which also will offer a minimum of resistance to liquid flow through the valve during operation.

To those skilled in the art to which this invention relates, many changes in construction and widely differing embodiments and applications of the invention will suggest themselves without departing from the spirit and scope of the invention. For example, pressure could be applied to the toggle linkage from the opposite side with equal success. Likewise, many structural variations are contemplated such as other or different types of pressure-applying means or pairs of elements instead of the single channel members illustrated. It should be understood that the disclosures and the description herein are purely illustrative and are not intended to be in any sense limiting.

We claim:

1. A check-and-foot valve adapted to prevent water hammer effect and offering a minimum of resistance to fluid flow through the valve comprising a valve body; a valve seat in said valve body; a valve adapted to close against said valve seat in a leak-tight manner; a hinge mounting said valve on the valve body for movement between open and closed positions; and toggle means linking said valve to said valve body to supply closing pressure to said valve, including a first link pivoted to said valve at a point spaced from said hinge; a second link pivoted to said valve body at a point spaced from said hinge, the total length of said two links being less than the sum of the distances betwen said hinge and the two pivots for the links; a common pivotal joint connecting said links; and spring means connecting said common joint to said valve body adjacent said hinge the relative positioning of said respective parts being such that in a closed valve position the link members form a relatively flat obtuse angle, and in an open valve position said link members form a relatively pointed acute angle; whereby in said closed-valve position the relatively smaller spring pressure of the less extended spring means is applied substantially fully in a direction tending to straighten out said links and results in a valve-closing pressure much larger than said spring pressure, while in said open-valve position the relatively larger spring pressure of the more extended spring means tending to straighten out said links results in a valve-closing pressure much smaller than either of said aforementioned spring pressures.

2. The valve of claim 1 in which said links are of substantially equal length and the pivots for said links lie at substantially equal distances from said hinge, and the spring means extends along the line between said hinge and said common pivotal joint.

3. A spring-loaded check-and-foot valve providing a

leak-tight valve seal at relatively low loading or spring pressures and offering a minimum of frictional resistance to fluid flow therethrough when the volume of flow is sufficient to open the valve to the point where the toggle angle is somewhat less than 90°, comprising a valve body having a seat; a valve adapted to seal against said seat; a hinge on said valve body at the side of said seat mounting asid valve for movement between open and closed positions relative to said valve seat; and a toggle linkage between the valve and valve body and pressure-applying means operable on a knee joint of said toggle linkage tending to straighten it out, said toggle linkage comprising two links, one pivoted at one end to the valve at a spaced distance from said hinge, the other pivoted to one end to the valve body along a line at substantially a right angle to the closed position of the valve and at a space distance from said hinge, the other ends of said links being pivoted to each other, at said knee joint, the sum of said link lengths being less than the sum of distances from the link pivots to the hinge and greater than the direct distance between link pivots so that said toggle linkage assumes a relatively flat obtuse angle in a closed-valve position and a relatively pointed acute angle in an open position; and closure means exerting a maximum closing pressure on said valve in the closed position and a minimum closing force in the open position, thereby permitting a leak-tight closure while insuring a minimum pressure drop across the valve during operation.

4. The device of claim 3 in which said pressure-applying means is an expanded spring positioned within the angle formed by said toggle linkage and connected at one end to said knee joint and at its other end to the hinge.

5. A check-and-foot valve adapted to prevent water hammer effect and offering a minimum of resistance to fluid flow through the valve comprising a valve body; a valve seat in said valve body; a valve adapted to close against said valve seat in a leak-tight manner; a hinge mounting said valve on the valve body for movement between open and closed positions; and toggle means linking said valve to said valve body to supply closing pressure to said valve, including a first link pivoted to said valve at a point spaced from said hinge; a second link pivoted to said valve body at a point spaced from said hinge, the total length of said two links being less than the sum of the distances between said hinge and the two pivots for the links; a common pivotal joint connecting said links; and spring means urging said common joint toward said hinge the relative positioning of said respective parts being such that in a closed valve position the link members form a relatively flat obtuse angle, and in an open valve position said link members form a relatively pointed acute angle; whereby in said closed-valve position the relatively smaller spring pressure of the less extended spring means is applied substantially fully in a direction tending to straighten out said links and results in a valve-closing pressure much larger than said spring pressure, while in said open-valve position the relatively larger spring pressure of the more extended spring means tending to straighten out said links results in a valve-closing pressure much smaller than either of said aforementioned spring pressures.

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United States Patent Office

3,026,902
Patented Mar. 27, 1962

3,026,902

DRIP-PREVENTING VALVE

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7 Claims. (Cl. 137—484.2)

This invention relates to a novel check valve, and more particularly to a novel check valve for preventing drip from a fluid dispensing nozzle.

It is convenient to dispense fluids through a nozzle controlled by a main valve. A system for delivering gasoline, for example, includes a hand-operated nozzle with a rather long snout. A pump is provided to deliver the gasoline under pressure to the dispensing nozzle. When the control valve is actuated, the gasoline flows through the nozzle into the tank of the automobile. If only a main control valve is used, the flexible hose and valve body may be optionally drained, or maintained full of gasoline by the operator. The gasoline remaining within the hose and nozzle may drip from the nozzle between filling operations. A drip of this type may also be troublesome in dispensing other liquids such as valuable or corrosive chemicals. In an attempt to prevent selective drainage of the hose and nozzle, and to prevent excess drippage from the nozzle, it has been proposed to install various check valves in the nozzle body. Examples of these check valves may be seen in U.S. Letters Patent 1,722,985 and 2,553,888. These check valves, however, do not provide a complete solution to the problem. They present a substantial restriction to the free flow of the gasoline through the nozzle and they are not adapted for convenient field installation within existing nozzles.

An object of this invention is to provide a check valve for a fluid dispensig device which is relatively simple and provides relatively unobstructed flow in an opened condition.

Another object of this invention is to provide a check valve structure which is adapted for convenient field installation within existing fluid dispensing nozzles.

In accordance with this invention, a check valve of the butterfly disc type is provided. The butterfly disc is eccentrically pivoted within the fluid dispensing tube so that hydraulic pressure will cause the disc to rotate open when the fluid builds up to a predetermined pressure within the dispensing tube. A toggle-action means is provided to apply an adequate sealing force when the valve is in relatively closed positions and a lesser sealing force when the valve is in relatively opened positions. This helps the valve fly open once the initial pressure reaches the predetermined pressure even though the opening force exerted by the fluid in the disc lessens as the plane of the disc rotates out of the stream of fluid flow into more opened positions.

To help the valve in its intial opening movements, when the force applied by the toggle-action means is greatest, a portion of the valve disc remote from the pivot is extended to provide increased area for reacting with the flow of fluid.

The toggle action may be provided by a spring coupled to the valve disc by means of an angular link. When the valve disc is in relatively closed positions, the line of action of the spring is maintained remote from the pivot to apply relatively higher closing forces. When the valve assumes relatively open positions, the line of action of the spring moves closer to the pivot to minimize the closing force applied to the valve disc. The fluid flow, therefore, is able to rotate a maximum amount of the disc out of its path. Obstruction of fluid flow is thereby minimized when the valve is opened.

The entire assembly may be installed within a short length of tubing which may be conveniently inserted, for example, within the outlet tube of an existing fluid dispensing nozzle. An effective seal may be maintained between the valve disc and its seat by an O-ring installed within a groove provided in the edge of the valve disc. The pivot may be displaced from the plane in which the valve disc seats so that the disc moves entirely clear of the seat when it rotates into opened positions.

Novel features and advantages of the present invention will become apparent to one skilled in the art from a reading of the following description in conjunction with the accompanying drawings in which:

FIG. 1 is a view in elevation, partially in cross section, illustrating how an embodiment of this invention is installed within an existing fluid dispensing nozzle;

FIGS. 2 and 2A are cross-sectional views in elevation of an embodiment of this invention in different phases of operation;

FIG. 3 is a cross-sectional view taken through FIG. 2 along the line 3—3 and looking in the direction of the arrows; and

FIG. 4 is a cross-sectional view taken through FIG. 2, along the line 4—4 and looking in the direction of the arrows.

In FIG. 1 is shown a typical gasoline dispensing nozzle 10 including an outlet tube 12. The end of the outlet tube is broken away to show how a check valve 14, which is an embodiment of this invention, is conveniently installed within the outlet tube. The details of this check valve 14 are more clearly illustrated in FIGS. 2, 2A, 3 and 4.

FIGS. 2 and 2A show the check valve 14 as it is installed in any fluid dispensing tube, for example, the outlet tube 12 of a gasoline dispensing nozzle. The check valve is assembled to a short length of tubing 16 which may also be described as a thin-walled cylinder. This thin-walled cylinder 16 is secured within the tube 12 by being press fitted, for example. A more positive installation may be made, however, by pinning or soldering.

Referring to FIGS. 2 and 3 and 4 the various elements and their cooperative relationship are described. A pivot means is provided by a shaft 18 which is eccentrically mounted within the cylinder 16. This shaft 18 is, for example, a round steel wire approximately $\frac{1}{16}$ of an inch in diameter; and it is rotatably mounted, for example, within a pair of holes 20 drilled through the wall of cylinder 16. A round butterfly valve disc 22 is secured to the shaft 18 by means of a strap 24. Strap 24 is secured to the disc, for example, a pair of rivets 26. The spaces between rivets 26 and holes 27 in disc 22 are sealed, for example, by means of a rubber sealing compound which is, for example, applied to rivets 26 before they are secured in place by heating. Shaft 18 is secured, for example, to cylinder 16 in an off-center position so that the force provided by the fluid to opposite sides of disc 22 is unbalanced which causes disc 22 to rotate open when the force of the fluid exceeds a predetermined minimum pressure.

A circumferential groove 28 is provided, for example, in the outer edge of valve disc 22. An O-ring 30, for example, is installed within this groove 28 to provide resilient gasket means for sealing the valve. O-ring 30, for example, is made of rubber and of a diameter sufficiently large to seat firmly within the interior of the cylinder. The inner wall of the cylinder in the direction in which the larger portion of disc 22 rotates is tapered as shown at 32 to allow free motion of the disc in open-

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DRIP-PREVENTING VALVE

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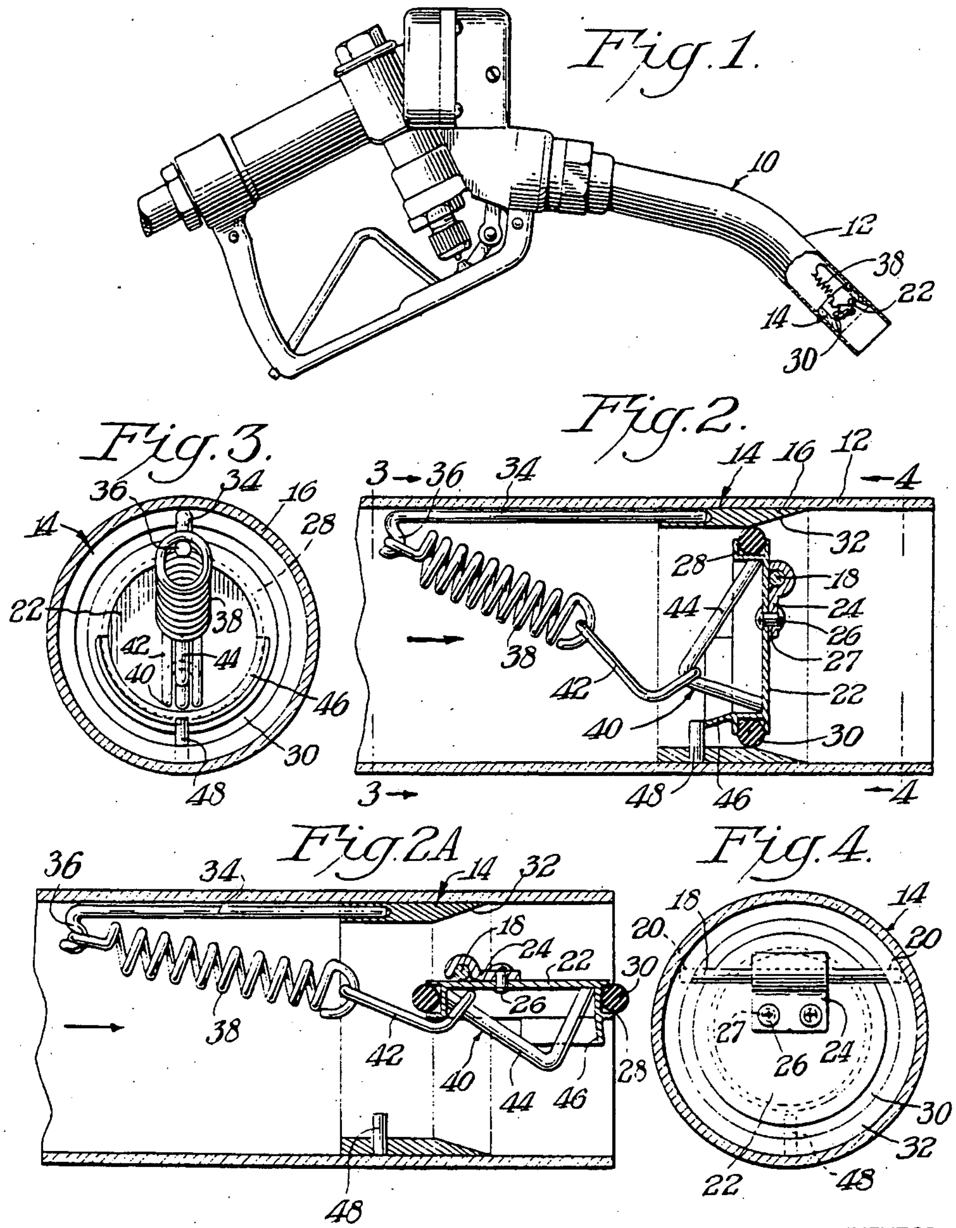

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ing and to provide adequate gasket and seat interference on closure.

A rod 34, for example, extends from cylinder 14 in the direction from which the fluid flows. This rod is disposed in line with the direction of fluid flow to offer minimum obstructing resistance to the flow of fluid. The end of the rod remote from the cylinder is hooked at 36 to provide means for anchoring the valve closing spring 38.

A toggle-action closing means, for maintaining the valve closed when the fluid pressure drops below a predetermined pressure, is provided, for example, by spring 38 connected to the valve disc 22, for example, by means of an angular link 40 secured to the face of the disc adjacent the direction from which fluid flows and a bent coupling link 42. This angular link or angular loop 40 is secured to the fluid face of the valve disc by soldering or brazing, for example. This link, for example, is shaped in the form of a triangle with its apex disposed at a point remote from the axis of pivot shaft 18. Spring 38 is connected to this loop through a bent link 42. Link 42 is bent to maintain the line of action of the spring as remote as possible from the pivot point when the valve is in relatively closed positions (as shown in FIG. 2) and to allow the line of action of spring 38 to be diverted around obstructing portions of valve disc 22. This allows the maximum amount of valve disc 22 to be rotated out of the stream of flow. The toggle-action means, therefore, allows the flowing fluid to maintain the valve forcibly rotated into maximum opened positions with minimum obstruction to the flow of fluid. Without this toggle action, the force applied by the spring would increase as the valve is rotated into more opened positions, and it would be difficult to provide enough fluid pressure to maintain the valve fully opened in a moving stream of fluid.

In order to help open the valve against the relatively high closing force applied in more closed positions, the edge of the disc remote from the pivot shaft 18 is extended parallel to the cylinder to form a fluid deflecting portion or cup 46. This fluid deflecting portion 46 is tapered slightly in an outward direction to present maximum area for reacting with the flow of fluid during the initial opening positions of the valve. This extension 46 is provided only on the half of the disc 22 most remote from the pivot shaft so that maximum force is developed by the flow of fluid for opening the valve.

A pin 48 extends within the cylinder in order to limit the closing moment of the valve disc. This pin 48 is struck by the inner edge of the deflector 46 to provide a positive limit for the closing travel of the valve and maintain the disc 22 perpendicular to the stream of flow when it is in the closed position.

The axis of the shaft 18 is, for example, displaced from the plane in which O-ring 30 seats to allow O-ring 30 to move completely free of the seat during the initial stages of the valve movement. This allows the valve to move free of its seat during most of its travel. An extremely free valve movement is thereby provided.

Operation

In operation, this valve provides extremely desirable mechanical and flow characteristics. As pressure builds up on the fluid side of the valve, it reacts on the larger portion of the valve disc to exert an unbalanced force which starts to open the valve. As the valve opens, the displacement of the plane of the valve disc from the pivot clears the disc from interference with the cylinder to allow progressively freer motion.

As the valve opens, the bent link 42 and angular link or loop 40 cooperate to shift the line of action of the spring from the apex of the triangle formed by loop 40 along arm 44 (as shown in FIG. 2) to a line adjacent the pivot shaft 18 (as shown in FIG. 2A). The apex of the triangle is remote from the pivot shaft and provides a moment arm relatively longer than the moment arm provided by portions of the arm 44 nearer the pivot shaft 18. Spring 38, therefore, exerts a greater closing force on the disc when its line of action is at the apex of the triangle rather than at portions of arm 44 adjacent to the pivot shaft. The valve, therefore, provides adequate seating force near closing positions and a desirable reduction in closing force when the valve is rotated by the fluid pressure to relatively opened positions. This lowering in the closing force at opened positions aids in rotating a maximum amount of the valve disc in line with the fluid stream to offer minimum resistance to fluid flow when it is in opened positions (as shown in FIG. 2A). The toggle action is instrumental in providing a positive acting check valve having highly desirable unobstructed flow characteristics.

The deflector or cup 46 first moves into positions substantially obstructing fluid flow in the initial stages of the valve opening movement. This aids in moving the valve to more opened positions against the relatively greater force applied by spring 38 during the initial opening stages of the valve movement.

Valves constructed in accordance with this invention have provided flow capacities equal to that provided by prior art valves, while requiring only approximately ¼ the delivery pressure. Due to the reduction in flow restriction, the valve also is much quieter in operation than prior art valves.

Incorporation of the entire structure within thin-walled cylinder 16 provides a highly compact device which may be conveniently installed in the field within existing fluid dispensing nozzles. One of these assemblies may be easily press fitted, for example, within the outlet tube of an existing gasoline dispensing nozzle. The assembly may be fitted within outlet tubes of varying sizes, for example, by provision of shim sleeves which may be slipped over the outer wall of cylinder 16 to provide a close fit within outlet tubes of varying sizes.

This invention includes parts of simple configuration that may be produced by modern production methods such as automatic screw machines, drill jigs and punch presses. They may also be inexpensively produced by diecasting methods. It may be advantageously used in any fluid system where drip is objectionable, such as where this fluid is, for example, expensive, toxic, corrosive or explosive.

What is claimed is:

1. A check valve comprising a tube, a valve disc of a size and shape substantially corresponding to an inner surface of said tube, rotatable means upon said tube providing an axis of rotation for said valve disc, said valve disc being mounted within said tube by said rotatable means to permit said valve disc to rotate from a closed position in which it engages said inner surface of said tube to open positions, a loop connected to said valve disc, said loop having a portion disposed close to said axis of rotation and another portion disposed remote from said axis of rotation, a spring anchored to said tube and connected to said loop for urging said valve disc towards closed postions, said portions of said loop being connected with each other in such a manner as to shift the line of action of said spring closer to said axis of rotation when said valve disc is in relatively opened postions to minimize the force required to maintain said valve opened when said disc is oriented in said relatively open positions, said axis of rotation being disposed closer to one side of said tube to eccentrically pivot said valve disc within it, the portion of said loop remote from said axis of rotation being closer to the point at which said spring is anchored to said tube when said valve disc is in the closed position, said other portion of said loop closer to said axis of rotation being closer to said anchoring point of said spring in said tube when said disc is in said relatively open positions, said loop being attached to the upstream side of said disc, said spring being anchored to a point in said tube upstream of said disc, an angular link connecting the end of said spring to said loop, and said link being bent away from said axis of rotation to permit

the line of action of said spring to be diverted around obstructing portions of said valve disc.

2. A check valve comprising a tube, a valve disc of a size and shape substantially corresponding to an inner surface of said tube, rotatable means upon said tube providing an axis of rotation for said valve disc, said valve disc being mounted within said tube by said rotatable means to permit said valve disc to rotate from a closed position in which it engages said inner surface of said tube to opened positions, a loop connected to said valve disc, said loop extending from one portion which is relatively close to said axis of rotation to another portion which is relatively remote from said axis of rotation, a spring anchored to said tube and loosely connected to said loop for urging said valve disc towards closed positions, said spring and said loop being constructed and arranged to dispose said portion of said loop relatively remote from said axis of rotation nearer to the point of anchoring said spring when said valve disc is in said closed position to forcefully maintain said valve disc closed, said spring and said loop being constructed and arranged to dispose said portion of said loop relatively close to said axis of rotation nearer to the point of anchoring of said spring when said valve disc is in opened positions to minimize the force required to maintain said valve in said opened positions, and said portions of said loop being smoothly connected with each other from said one portion to the other which permits the point of connection of said spring to said loop to automatically shift from one of said portions of said loop to the other in accordance with which of said portions is nearer to said point of anchoring of said spring as said valve disc moves from opened to closed positions.

3. A check valve as set forth in claim 2 wherein said axis of rotation is disposed closer to one side of said tube to eccentrically pivot said valve disc within it.

4. A check valve as set forth in claim 3 wherein said loop is attached to the upstream side of said disc, and said spring is anchored to a point in said tube upstream of said disc.

5. A check valve as set forth in claim 2 for convenient installation within a fluid conducting tube wherein said tube is comprised of a length of tubing for insertion within a fluid-conducting conduit, an extension projects from said length of tubing away from the upstream side of said disc to provide means for anchoring said spring, and said loop is attached to the upstream side of said disc.

6. A check valve as set forth in claim 2 wherein gasket means are installed about the outer edge of said disc to help seal the junction between said disc and said inner surface of said tube.

7. A check valve as set forth in claim 2 wherein a flow-obstructing projection extends from the upstream side of said disc at a portion thereof remote from said axis of rotation to provide increased area for reacting with fluid passing through said valve to maintain said disc in opened positions.

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CRANKCASE VENTILATOR FOR AUTOMOTIVE VEHICLES

Filed Aug. 28, 1961

2 Sheets-Sheet 1

FIG. 1.

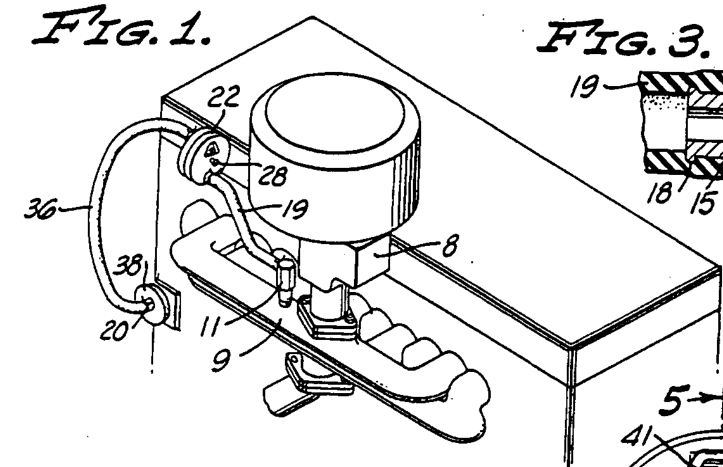


FIG. 3.

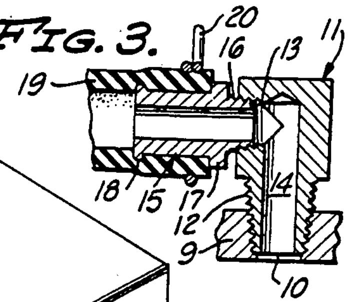
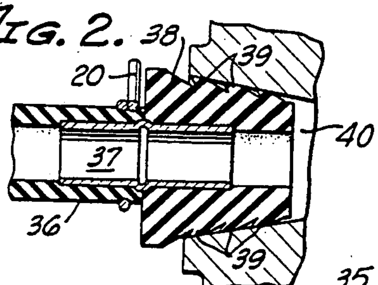


FIG. 2.



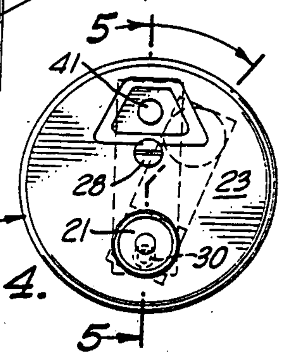


FIG. 4.

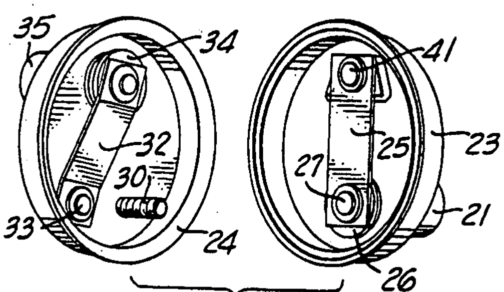


FIG. 6.

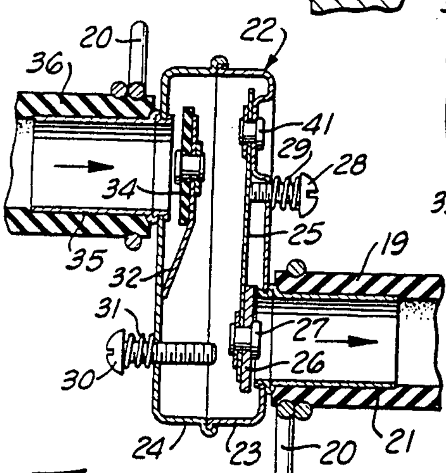


FIG. 5.

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CRANKCASE VENTILATOR FOR AUTOMOTIVE VEHICLES

Filed Aug. 28, 1961 2 Sheets-Sheet 2

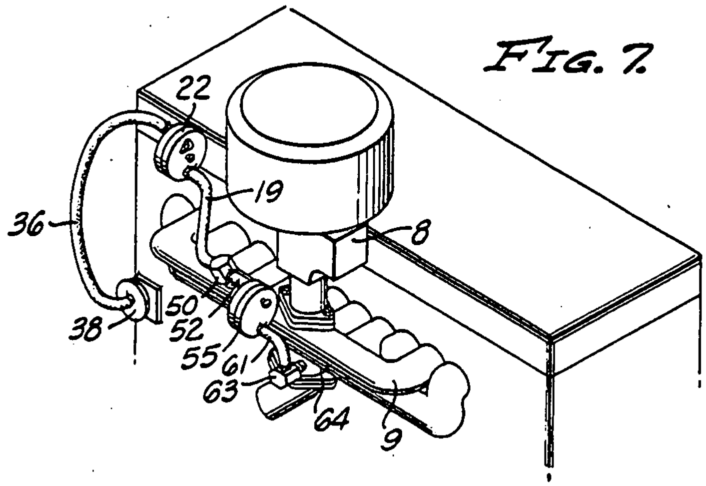


FIG. 7.

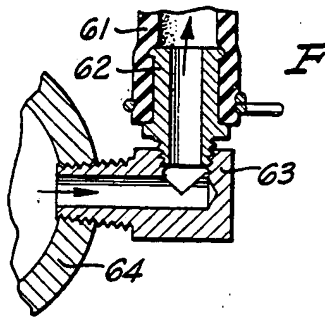
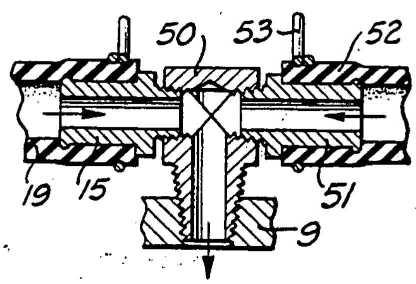


FIG. 8.

FIG. 9.



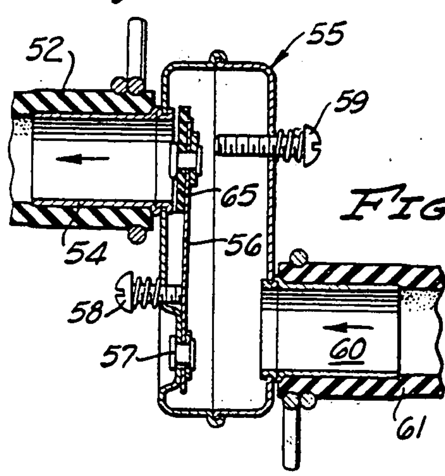


FIG. 10.

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3,051,151
CRANKCASE VENTILATOR FOR AUTOMOTIVE VEHICLES

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7 Claims. (Cl. 123—119)

This invention relates to a crankcase ventilator for automotive vehicles.

It is an object of my invention to provide a ventilator which is adapted to be quickly and easily installed on existing automobile vehicles for the purpose of providing accurately controlled ventilation of the crankcase. This ventilation takes oil fumes from the crankcase and carries them back to the carburetor, resulting in increased gasoline mileage due to the recovery of a formerly wasted source of fuel. It also removes the same fumes from the exhaust, reducing the creation of smog through operation of the vehicle. My invention accordingly increases the operating efficiency of the vehicle and reduces its exhaust gases.

It is a more particular object of my invention to provide a universal crankcase ventilator kit which can be utilized by an automobile mechanic of average skill to install my crankcase ventilator on substantially any make or model of automotive vehicle.

Another object of my invention is to provide such a kit which is capable of being manufactured economically and installed quickly so that its cost of manufacture and installation are well within the budget of substantially every driver of automotive vehicles.

It is also among the objects of my invention to provide a crankcase ventilator kit which is simpler and easier to install than other such devices which are now in use.

Yet another object of my invention is to provide a crankcase ventilator which is simpler and more efficient in its construction than similar devices now in use and which will last longer and will not become sludged up or rendered inoperable in use.

Another object of my invention is to provide a device which is also capable of being used to carry exhaust gases from the exhaust manifold of the vehicle back to the intake manifold. My device may be so used either alone or in combination with another device used as a crankcase ventilator. It has been found that the combination of the two devices is particularly effective in improving the gasoline mileage of the vehicle.

My invention also comprises such other objects, advantages and capabilities as will later more fully appear and which are inherently possessed by my invention.

While I have shown in the accompanying drawings preferred embodiments of my invention, it should be understood that the same are susceptible of modification and change without departing from the spirit of my invention.

Referring to the drawings:

FIG. 1 is a perspective view of a portion of an automotive vehicle engine, showing my crankcase ventilator in use thereon;

FIG. 2 is an enlarged detailed sectional view of the connection of the ventilator to the road draft port;

FIG. 3 is an enlarged detailed sectional view of the connection of the ventilator to the intake manifold;

FIG. 4 is an enlarged side elevational view of the valve control member;

FIG. 5 is an enlarged detailed sectional view taken on lines 5—5 of FIG. 4, showing both of the leaf springs in section;

FIG. 6 is a perspective view of the inside of the two

parts of the valve control member which is shown in section in FIG. 5;

FIG. 7 is a perspective view of an alternative embodiment of my invention, showing a portion of an automotive vehicle engine, with my crankcase ventilator in use in combination with a second valve control member for carrying heated air from the exhaust manifold back to the intake manifold;

FIG. 8 is an enlarged sectional view of the connection of this embodiment of my invention to the exhaust manifold;

FIG. 9 is an enlarged sectional view of the T-fitting connection of this embodiment of my invention to the intake manifold;

FIG. 10 is an enlarged sectional view of the second valve control member of this embodiment of my invention.

A preferred embodiment which has been selected to illustrate my invention is connected at one end to the intake manifold 9 of the automotive vehicle. Referring to FIG. 3 of the drawings, an opening 10 is drilled into the intake manifold as close to the base of the carburetor 8 as possible. Care must be taken not to drill the opening 10 into the exhaust passage which runs through many manifolds. A self-tapping fitting 11, which is part of my crankcase ventilator kit, has a screw threaded lower end 12, which is inserted into the opening 10.

The upper end of the fitting 11 is provided with an internally screw threaded opening 13, which extends horizontally inwardly from the side of the fitting 11 and connects with a passage 14, which extends downwardly through the screw threaded lower end 12.

A hollow hose connector 15 has an externally screw threaded end 16 which fits within the opening 13 in the fitting 11. The connector 15 has a hexagonal flange 17 which is disposed adjacent to the screw threaded end 16. The end of the connector 15 remote from the end 16 is provided with an annular bead 18.

A hose 19 is preferably formed of oil and gasoline resistant material such as neoprene. One end of the hose 19 fits over the unthreaded end of the connector 15. The hose 19 fits over the bead 18 and abuts against the flange 17. A circular spring clip 20 fits around the end of the hose 19 to secure it firmly to the connector 15.

The opposite end of the hose 19 is connected to the hollow outlet tube 21 of a valve control member 22. The hose 19 is held in place by another spring clip 20. The valve control member 22 includes a casing having two parts 23 and 24, which are secured together. The outlet tube 21 is connected to the casing part 23.

Mounted within the casing part 23 is an elongated leaf spring 25, one end of which is secured to the casing part 23 by a rivet 41. The opposite end of the leaf spring 25 carries a circular metal seal 26, which is secured thereto by a rivet 27. The seal 26 is disposed adjacent to the inner end of the outlet tube 21 and is normally urged by the leaf spring 25 toward a position in which it engages and closes off the inner end of the outlet tube 21.

A first adjusting screw 28 extends through the casing part 23 so that its inner end engages the end of the leaf spring 25 adjacent to the rivet 41. The head of the screw 28 is slotted to permit its adjustment by use of a screwdriver. A coil spring 29 surrounds the shank of the screw 28 between the head and the casing part 23 to prevent accidental or undesirable rotation of the screw 28 and hold it in the position to which it is adjusted.

A second adjusting screw 30 extends through the opposite casing part 24 and has its inner end disposed adjacent to and in alignment with the circular seal 26. The

screw 30 is similarly provided with a slotted head and a retaining coil spring 31. It will be noted that the first adjusting screw 28 when moved inwardly acts to move the seal 26 away from the inner end of the outlet tube 21 to permit a small amount of flow through the outlet tube 21. The second adjusting screw 30, when moved inwardly, acts to limit the opening movement of the seal 26 in order to make its subsequent return to closed position more certain.

A second and non-adjustable leaf spring 32 is mounted within the casing part 24 by a rivet 33 which extends through one end of the leaf spring 32. The other end of the spring 32 carries a resilient circular seal 34. The seal 34 is aligned with and disposed adjacent to the inner end of an inlet tube 35, which is connected to the casing part 24. The leaf spring 32 is bent so that the seal 34 is normally spaced a substantial distance away from the inner end of the inlet tube 35, as shown in FIG. 5 of the drawings.

A second hose 36 is connected at one end to the inlet tube 35 and held there by a spring clip 20. The opposite end of the second hose 36 fits over one half of a hollow connector 37 and is held thereon by a spring clip 20. The other half of the connector 37 fits within a resilient plug 38, the outer periphery of which is provided with serrations 39 which frictionally engage the inner walls of the road draft port 40 of the automotive vehicle, from which the road draft tube has first been removed.

These comprise all of the portions of my crankcase ventilator and kit. In order to adjust the ventilator after it has been installed in the manner described, the motor of the vehicle is warmed up and a vacuum gauge is used with the engine at idle speed. The first adjusting screw 28 is tightened until the vacuum gauge gives a reading ¼" to ½" less than the normal reading. This does not adversely affect the idling operation of the vehicle.

The vehicle is then put in gear and the motor speed increased slowly until the leaf spring 25 opens. This is indicated by a sharp decrease in the vacuum gauge reading. After the spring 25 opens, the motor speed is decreased slowly to idle and the second adjusting screw 30 is tightened until the spring 25 closes. The closing of the spring 25 can be heard and is also indicated by a sharp increase in the vacuum indication on the gauge. The engine speed is then increased and decreased slowly several times to be certain that the spring 25 just closes as the engine returns to idling speed. The second screw 30 is then tightened three additional rotations.

The purpose of the second adjusting screw 30 is to prevent the spring 25 from opening too far and to make certain that it returns to its closed position. The setting of the second adjusting screw should be such that the spring 25 will return to its closed position when the vacuum is in the range from six inches to twelve inches. The closing of the spring 25 cuts off the supply of air to the intake manifold, to prevent malfunctioning of the engine due to too lean a mixture.

It should be noted that when the motor of the vehicle is at idle speed, the adjusting screw 28 holds the seal 26 a slight distance away from the inner end of the outlet tube 21, despite the high vacuum which urges the seal 26 toward closed position. When the motor is accelerated, the amount of vacuum is decreased and the spring 25 moves the seal 26 a substantial distance away from the outlet tube 21 and into engagement with the inner end of the second adjusting screw 30. When the motor is decelerated back toward idle, the vacuum increases and moves the seal 26 back toward the outlet tube 21 against the pressure of the leaf spring 25.

The leaf spring 32 is a safety precaution to prevent a backfire from going back to the crankcase, which contains explosive gases. A backfire will move the seal 34 into sealing engagement with the inlet tube 35, to prevent the backfire from reaching the crankcase.

Referring to FIGS. 7–10 of the drawings, a second device of substantially the same construction described above can be installed on the vehicle simultaneously with the crankcase ventilator to carry a limited amount of heated air from the exhaust manifold to the intake manifold. This combination results in a saving of gasoline and a corresponding increase in the miles per gallon ratio of the vehicle, particularly at speeds under 50 miles per hour.

This construction is extremely similar to the one described above and will accordingly be summarized briefly. It utilizes a T-fitting 50, which extends into an opening in the intake manifold. A crankcase ventilator is connected to one side of the T-fitting 50. Since this ventilator is identical with the device described above, the same reference numbers have been utilized. Connected to the other side is a connector 51, to which one end of a hose 52 is held by a spring clip 53. The opposite end of the hose 52 is connected to the outlet tube 54 of a second valve control member 55. Mounted within the second valve control member 55 is a leaf spring 56, which is held by a rivet 57. The leaf spring 56 carries at its opposite end a seal 65, which is adapted to close off the outlet tube 54. A first adjusting screw 58 and second adjusting screw 59 are constructed and function in the same manner described above. There is no second or backfire spring utilized in the second valve control member 55.

The inlet tube 60 of the second valve control member 55 is connected to one end of a second hose 61, the opposite end of which is secured to a connector 62. The connector 62 is screw threadedly connected to a self-tapping fitting 63, which extends into an opening drilled into the exhaust manifold 64.

In use, it has been found that the combined action of the crankcase ventilator and controlled return from the exhaust manifold provides improved gasoline mileage for the vehicle.

I claim:

1. A device of the class described for automotive vehicle engines of the type having an intake manifold and a crankcase, said device comprising a fitting screw threadedly extending into an opening in the intake manifold, a hose having one end thereof connected to said fitting, a valve control member having an inlet tube on one side thereof and an outlet tube on the other side, the opposite end of said hose being connected to said outlet tube, an elongated leaf spring mounted within said control member and secured at one end thereof to said control member, a seal carried by the opposite end of said leaf spring, said seal being adapted to close off said outlet tube, a first adjusting screw mounted on one side of said control member and adapted to engage one side of said leaf spring between the ends thereof to move said seal away from said outlet tube, a second adjusting screw mounted on the opposite side of said control member and adapted to engage the other side of said leaf spring adjacent to said seal to limit the movement of said seal away from said outlet tube, a second hose having one end thereof connected to said inlet tube, the opposite end of said hose being connected to a resilient hollow plug, said plug having external serrations engaging the walls of an opening in the crankcase.

2. The structure described in claim 1 and a second leaf spring mounted within said valve control member, said leaf spring having a seal at one end thereof adapted to close off said inlet tube, said second leaf spring being bent so that said inlet tube is normally open, said spring adapted to be flexed to move said seal and close off said inlet tube to prevent a backfire from passing through said control member into the crankcase of the vehicle.

3. A device of the class described for automotive vehicle engines of the type having an intake manifold and

a crankcase, said device comprising a fitting extending into an opening in the intake manifold, a hose having one end thereof connected to said fitting, a valve control member having an inlet tube and an outlet tube, the opposite end of said hose being connected to said outlet tube, an elongated leaf spring mounted within said control member, a seal carried by said leaf spring, said seal being adapted to close off said outlet tube, a first adjusting screw on said control member adapted to engage one side of said leaf spring between the ends thereof to move said seal away from said outlet tube, a second adjusting screw on said control member adapted to engage the other side of said leaf spring adjacent to said seal to limit the movement of said seal away from said outlet tube, a second hose having one end thereof connected to said inlet tube, the opposite end of said hose being connected to a resilient hollow plug, said plug frictionally engaging the walls of an opening in the crankcase.

4. A device of the class described for automotive vehicle engines of the type having an intake manifold and a crankcase, said device comprising a fitting connected to the intake manifold, a hose having one end thereof connected to said fitting, a valve control member having an inlet and an outlet, the opposite end of said hose being connected to said outlet, an elongated leaf spring mounted within said control member, a seal carried by said leaf spring, said seal being adapted to close off said outlet, a first adjusting screw on said control member adapted to engage said leaf spring to move said seal away from said outlet, a second adjusting screw on said control member adapted to limit the movement of said seal away from said outlet, a second hose having one end thereof connected to said inlet, the opposite end of said hose being connected to a resilient hollow plug, said plug being connected to the crankcase.

5. A device of the class described for automotive vehicle engines of the type having an intake manifold and a

crankcase, said device comprising a valve control member having an inlet connected to the crankcase and an outlet connected to the intake manifold, an elongated leaf spring mounted within said control member, a seal carried by said leaf spring adapted to close off said outlet, a first adjusting screw on said control member adapted to move said seal away from said outlet and a second adjusting screw on said control member adapted to limit the movement of said seal away from said outlet.

6. The structure described in claim 5, said engine having an exhaust manifold, and a valve control member having an inlet connected to the exhaust manifold and an outlet connected to the intake manifold, an elongated leaf spring mounted within said second control member, a seal carried by said leaf spring adapted to close off the outlet of said second control member, and an adjusting screw on said second control member adapted to move said seal away from the outlet of said second control member.

7. In an automotive vehicle engine of the type having an intake manifold, an exhaust manifold and a crankcase, a first valve control member having an inlet connected to the crankcase and an outlet connected to the intake manifold, means carried by said valve control member for controlling the flow of gases from the crankcase to the intake manifold and a second valve control member having an inlet connected to the exhaust manifold and an outlet connected to the intake manifold, and means carried by said valve control member for controlling the flow of gases from the exhaust manifold to the intake manifold.

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Patented Mar. 16, 1965

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3,173,439

BACKFLOW PREVENTION DEVICE

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Filed June 26, 1961, Ser. No. 119,553

28 Claims. (Cl. 137—107)

This invention relates to backflow prevention devices adapted to prevent contamination of public water distribution systems supplying drinking water to dwellings, hotels, factories, shipyards, docks and other facilities, public buildings, etc.

Sanitary engineers and health authorities are now more concerned than ever before with the importance of protecting public water supply systems against contamination resulting from cross-connections or back siphonage of unpotable water into the city water mains from a consumer's property. The records are replete with histories of epidemics of amoebic dysentery and other ailments which have resulted in serious illnesses and, in many instances, death, and which are directly traceable to the pollution of water supply systems.

While previous attempts have been made to meet the problem of backflow prevention, there still remains a need for a simple device that provides positive protection against backflow, but which is not affected by variations in line pressure, and which does not produce an excessively high pressure drop at the consumer's supply point during normal flow condition and under periods of high demand such as might occur during a fire. Thus, whereas prior units operate properly at certain line pressures, but waste water by excessive discharge of water to atmosphere upon increase in line pressure, the present unit is relatively unaffected by such variations. Also, whereas prior units have produced a line pressure drop of about 20 p.s.i., the present units operate with an appreciably lower pressure drop of 8½ p.s.i. under corresponding flow rates in gallons per minute (g.m.p.).

Most backflow prevention units include shut-off valves of some sort at the opposite ends of the unit, two check valves between the shut-off valves, and a relief valve arranged to drain the space between the two check valves in the event that a backflow or other malfunction arises. The check valve at the end of the unit that is connected with the water main is commonly referred to as the first check, or number one check, and the check valve at the end of the unit connected with the consumer's pipe system is commonly referred to as the second check, or the number two check.

The foregoing advantages of the present backflow prevention unit are attained by using specially designed check valves that function without inducing high pressure drops across the unit, and by employing with these check valves, a specially designed relief valve that will respond to low differential pressures, and wich is unaffected by variations in line pressure, within the operating pressure range of the unit.

The principal object of the invention is to provide a backflow prevention device that will meet and comply with all known sanitation requirements.

Another object is to provide a dependable backflow unit that will positively prevent all return flow of water therethrough from the consumer's pipe system to the water supply mains, or from any non-potable source of water to a potable system within a consumer's property.

Another object is to provide a backflow unit, including check valves that are positively closed and maintained closed by a toggle lever arrangement whenever the pressure at the supply main end of the unit is approximately equal to that at the service pipe end of the unit, and which check valves are positively held closed by the toggle mechanism except when the difference in pressure between the supply main and the service pipe exceeds the closing forces acting on the check valves by a predetermined amount.

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Another object is to provide a backflow unit, including a pair of check valves which, when in their open position, permit a clear or substantially unobstructed flow of water through the unit.

Another object is to provide a blackflow unit which includes check valves that provide for a low pressure drop across the unit, and wherein the first check valve produces a greater pressure drop than the second check valve.

A very important object is to provide a backflow unit having a relief valve that will open in response to a low pressure differential across the first check valve.

A still further object is to provide a backflow unit that can be completely assembled at the factory, shipped in toto, readily installed in a water supply main as an assembled unit, and serviced by gaining access to the working parts of the valves without removing the unit from the main.

A further and more specific object is to provide a check valve that provides for substantially unobstructed flow therethrough, and which includes a toggle lever system normally urging the valve to closed position with a powerful and increasing force as the closed position is approached, and which requires a relatively low pressure differential to effect opening thereof, and wherein the force required to hold the valve open decreases as the flow rate increases in the normal operational range of the unit.

Another specific object is to provide a pressure differentially operated relief valve wherein the pressures are substantially balanced so that it will not open until the differential pressure is about 2 pounds or less, regardless of variations in line pressure within the pressure range of the unit, whereby needless opening of the relief valve and waste of water is avoided.

Other objects and advantages of the invention will be pointed out hereinafter and will be apparent from the following description taken in conjunction with the accompanying drawings in which:

FIG. 1 is an elevational view of a backflow prevention unit embodying the principles of the present invention;

FIG. 2 is a plan view of the backflow unit shown in FIG. 1;

FIG. 3 is a diagrammatic, longitudinal sectional view through the backflow unit of FIG. 1, but showing the parts of the check valves and relief valve in the positions they assume during a normal flow condition;

FIG. 4 is a view similar to FIG. 3, but showing the check valves and the relief valve in the positions they assume during a backflow or leakage condition of the check valve at the consumer end of the unit;

FIG. 5 is an enlarged vertical sectional view through one of the check valves, taken on the line 5—5 of FIG. 2, showing the valve in fully closed position;

FIG. 6 is a view similar to FIG. 5, but showing the valve in its fully open position;

FIG. 7 is a horizontal sectional view taken on the line 7—7 of FIG. 5;

FIG. 8 is a fragmentary vertical sectional view taken on the line 8—8 of FIG. 6;

FIG. 9 is an enlarged fragmentary sectional view illustrating certain important details of the seat and valve disc retainer of the check valve shown in FIG. 5;

FIG. 10 is a vertical sectional view through the pressure differential operated relief valve taken on the line

10—10 of FIG. 2. the valve inlet being shown out of correct phase to facilitate illustration;

FIG. 11 is an enlarged fragmentary sectional view of the seat and cooperating valve element of the relief valve shown in FIG. 10;

FIG. 11A is a fragmentary sectional view of a modified seat;

FIG. 12 is a graph showing the pressure characteristics of a backflow unit for a 2" pipe line, including an indication of the pressure loss at various flow rates across the entire unit, across the first check valve and across the second check valve; and

FIG. 13 is a similar graph for a backflow unit for a 4" pipe line.

Referring to FIGS. 1 and 2, the backflow unit comprises a first check valve **1** and a second check valve **2**, the valves having flanged ends connected by bolts **3**. A conventional, flanged gate valve **4** is secured at the inlet side of the check valve **1** by bolts **5**, and the inlet of the gate valve **4** is connected to a supply main **6** (shown in dot-and-dash lines) by bolts **7**. A conventional, flanged gate valve **8** is connected to the outlet end of the check valve **2** by bolts **9**, and its outlet side is connected with a service pipe **10** (shown in dot-and-dash lines) by bolts **11**. A relief valve **12** is connected by a pipe nipple **12*a*** with the check valve **1** so that its inlet communicates with a zone Z including the outlet of the check valve **1** and the inlet of the check valve **2**, as is best indicated in FIG. 4. The relief valve **12** includes pressure chambers (described later) that are connected with the inlet side of the sheck valve **1** by a conduit **13** and with the inlet side of the check valve **2** by a conduit **14**.

The gate valves **4** and **8** are conventional and serve as shut-off valves for isolating the backflow unit from either the supply main **6** or the service pipe **10** for inspection or repair.

The check valves **1** and **2** are preferably alike and a description of one will suffice for both. The details of the check valve are shown in FIGS. 5 to 9, wherefrom it will be seen that the valve includes a body **15** having an inlet **16** and an outlet **17** axially aligned therewith. The inner end of the inlet **16** is threaded to receive a seat **18**. As is best shown in FIG. 9, the valve body **15** is machined to privide a flat, annular shoulder **19** disposed perpendicular to the axis of the seat **18**. The seat **18** has a flat surface **20** that engages the shoulder **19**. A flange **21** projects laterally from the seat **18** and is spaced from the shoulder **20**. The inner face **22** of the seat **18** is beveled on an angle of about 5° and merges into a chamfered portion **23**. The purpose of the flange **21** will be explained more fully hereinafter.

The seat surface **22** is adapted to be engaged by a disc **24** which may be of synthetic rubber or other yieldable material. The disc **24** is received in a groove **25** in a disc retainer **26** having a marginal flange **27** of approximately the same outside diameter as the flange **21**, so that it is adapted to engage therewith under abnormal wear or compression of the disc **24**, as will be explained more fully hereinafter. The disc retainer **26** has a centrally threaded opening **28** for receiving a screw **29** that extends through a disc guide **30** to clamp the disc **24** in place.

The disc retainer **26** also has a pair of spaced ears **32** which receive a pin **33** for pivotally connecting one end of a pair of links **34** thereto. The pin **33** extends through a hinge member **35** that has a laterally extending eye **37** for pivotally mounting the same upon a pin **38**. The valve body **15** has aligned threaded openings **39** in the opposite side walls thereof for receiving the pin **38**. Plugs **40** mounted in the openings **39** retain the pin **38** within the valve body **15**.

The valve body **15** also has aligned bosses **41** on the opposite sides thereof which have openings **42** for a pin **43**. The outer ends of the openings **42** are threaded and closed by plugs **44**. A lever arm **45** has a pair of spaced ears **46** at one end that have openings for pivotally mounting the same upon the pin **43**. Triangular webs **47** reinforce the lever **45** adjacent the ears **46**. The opposite ends of the lever **45** is connected by a pin **48** with the links **34**, and as is evident from the drawings, the distance between the axes of the pins **43** and **48** is slightly less than about four times the distance between the axes of the pins **33** and **48**.

A yoke **49**, see FIG. 8, has a pair of depending ears **50** through which the pin **48** extends. As is here shown, the lever **45** is mounted on the pin **48** between the links **34**. The yoke **49** includes an elongated cylindrical portion **51** that is tapered at its upper end **52**. The cylindrical portion **51** has diametrical, outwardly projecting stops **53** at its base. A compression spring **54** seats on the yoke **49** in the region of the stops **53**.

The valve body **15** has a circular opening **55** at its upper end that is closed by a cover **56** having a central conical boss **57**. A gasket **58** is disposed between the body **15** and the cover **56**. Bolts **59** extend through the cover **56** and gasket **58** into threaded openings in the body **15** for mounting the cover **56** in place. A threaded vent opening **60** in the boss **57** is closed by a plug **61**. The interior of the boss **57** includes a shoulder **62** that serves as a seat for the upper end of the spring **54**.

It will be understood that the proportions and arrangement of the lever **45**, the links **34** and the pivot pins **33**, **38**, **43** and **48** are such that a toggle mechanism is formed wherein, when the valve is fully opened, the axis of the pin **48** lies above a line drawn through the axes of the pivot pins **33** and **43** and that when the valve is fully closed the axes of the pin **48** lies on a line intermediate lines drawn through the axes of pivot pins **43** and **33**. It will also be understood that the spring **54** acts on the toggle linkage through the yoke **49**, tending at all times to urge the valve disc **24** into engagement with the seat surface **22**. It will be further observed that the valve body **15** is devoid of any interior obstructions between the valve seat **18** and the outlet opening **17**, whereby fluid can flow through the valve with a minimum pressure loss. It will be still further understood that when the valve is in its wide-open position, as shown in FIG. 6, pivot pin **48** is substantially vertically aligned with the axis of the spring **54**, and that the stops **53** on the yoke **49** engage the lower surface of the cover **56** and positively limit the extent of opening of the valve and also the extent of compression of the spring **54**. This spring is preferably made of stainless steel and is designed so that for a 2" valve, a pressure differential of about 5.6 p.s.i. is required to start opening movement of the first check valve **1**, with a required increase in this differential up to slightly under 8 p.s.i. to initially open the valve approximately one to two degrees. The 8 p.s.i. differential pressure, it will be noted, corresponds to a flow rate of about 6 g.p.m. However, once the check valve has been opened, the differential pressure required to maintain the same open, decreases as the rate of flow increases. Thus, at a flow rate of about 90 g.p.m., the pressure loss through the first check valve, due to the force required to maintain the valve open, is about 4.6 p.s.i., or about 1 p.s.i. less than the unseating force.

The second 2" check valve **2** is preferably identical to the check valve **1**, but is provided with a weaker spring **54*a***, FIG. 3, having the pressure loss characteristics illustrated in FIG. 12. Thus, the pressure differential required to unseat the disc of check valve **2** is about 1.8 p.s.i. rising to about 2.6 p.s.i. to effect opening of the valve, with a flow of about 4 g.p.m. As the flow rate increases, there is a decrease in the pressure drop so that for the same flow rate of 90 g.p.m., the pressure drop is about 2.2 p.s.i. and gradually increases as the flow rate increases. The overall pressure drop characteristics of the backflow unit are represented by the top curve of FIG. 12.

In the case of a unit having 4" check valves, the valves and springs are designed so that the pressure drop incident to unseating the valve discs is about the same as in the 2" unit, as will be seen from a comparison of FIG. 13

with FIG. 12. In the 4" unit also, the pressure drop decreases as the flow rate increases, except when extremely high flow rates are reached.

A 1" pressure differential relief valve may be used for ¾" to 2½" backflow units and a 2" relief valve may be used for 3" to 10" backflow units.

The details of the differential pressure relief valve 12 are shown in FIGS. 10 and 11. This valve has a body made of four sections 63, 64, 65 and 66. The lowermost section 63 has a threaded inlet opening 67 for receiving one end of the pipe nipple 12a, the other end of which is mounted in a threaded opening 69 formed in a boss 70 projecting from a side wall of the check valve body 15, as indicated in FIG. 7. The section 63 has a partition 71 with a threaded opening in which a seat 72 is mounted. A discharge opening 73 is disposed below the seat 72 and its upper portion is somewhat dome-shaped, as indicated at 74, in order to provide minimum resistance to the discharge of water through the seat 72. The outlet 73 is devoid of threads and is surrounded by a bead 75a in order to avoid attempts to attach a pipe or other conduit to said outlet, which is intended to discharge to the atmosphere.

The body section 63 includes an upper wall 75 having an opening 76, which slidably receives an enlarged portion 77 of a valve stem 78. The lower end 79 of the valve stem is reduced and threaded and extends from a shoulder 80 that forms an abutment for a clamping disc 81. A disc retainer 82 has a groove 83 containing a valve disc 84. The retainer 82 is mounted on the stem portion 79 and is held in place by a nut 85. The disc 84 co-operates with the seat 72 for controlling flow through the relief valve 12.

As is best shown in FIG. 11, the seat 72 has an internal conical surface 86 which slopes on an angle of about 25° relative to the axis of the stem 78. The conical surface merges into a cylindrical surface 87 defining, in part, a raised seat or ridge 88. The outer surface of the ridge 88 is formed on a slight radius starting at the cylindrical surface 87, and merges into an inclined outer surface 89 that extends on an angle of about 25°. This angle may be varied but should not exceed 40°.

The purpose of the raised seat 88 with its radius and inclined surface 89 is to prevent water discharging under pressure from creating a suction action that would tend to make the valve disc 84 flutter and/or suck it toward closed position, and thus close valve 12 when it should remain open. It will be noted incidentally that the portion of the valve stem 78 between the enlargement 77 and the reduced portion 79 is reduced in diameter to increase the flow capacity through the valve seat 72, the flaring adjacent to the clamping disc 81 aiding in streamlining the flow through the valve.

The upper wall 75 of the body section 63 is recessed as indicated at 90 for the reception of the lower end of the section 64. The lower surface of the section 64 has a groove 99, which receives the outer thickened edge 100 of a rolling diaphragm 101. A clamping disc 102 is mounted upon the valve stem 78 and engages the upper face of the stem enlargement 77 to form a support for the lower side of the diaphragm 101. The section 64 contains a chamber 103 that continuously communicates with the atmosphere through vent openings 104 located at the lower part of the chamber 103. A piston 105 is mounted upon a reduced upper extension 106 of the valve stem 78 and has a cylindrical central projection 107 that engages the upper surface of the diaphragm 101.

The section 64 has a groove 108 formed in its upper surface to receive the thickened margin 109 of a relatively larger rolling diaphragm 110. The lower surface of the diaphragm 110 engages the upper surface of the piston 105, and a clamping disc 111 engages the upper surface of diaphragm 110 to clamp it against the piston.

The section 65 has an intermediate transverse wall 112 provided with a central opening 113, which slidably receives a spacer sleeve 114, the lower end of which is engaged with the clamping disc 111.

The section 66 serves as a cover and has a groove 115 at its lower edge, which receives the thickened margin 116 of a rolling diaphragm 117 that is identical to the diaphragm 110. A clamping washer 118 is engaged with the upper end of the spacer 114 and forms a support for the lower side of the diaphragm 117. A piston 119 is mounted upon the stem portion 106 and engages the upper side of the diaphragm 117. The upper extremity of the stem 78 is threaded, and a nut 120 mounted thereon secures the clamping disc 102, diaphragm 101, piston 105, diaphragm 110, clamping disc 111, sleeve 114, clamping disc 118, diaphragm 117, and piston 119, in assembled relation with the valve stem 78. It will be noted that the clamping discs 102, 111 and 118 all have margins that are cupped to provide good support for the rolling diaphragms associated therewith. The valve stem surfaces 77 and 114 are fluorocarbon resin to provide a slippery surface to reduce friction in the operation of the relief valve.

The sections 64 and 65 are maintained in proper registration by a marginal ridge 121 on the section 64 and a complementary marginal recess 122 formed in the section 65. The section 65 and cover 66 are maintained in registration by a similar ridge and recess arrangement. As is shown in FIGS. 1 and 2, the section 63 has a generally square flange 123 at its upper end, and the cover section 66 has a similar flange 124 formed at its lower end. A stud 125 is mounted at each corner of the flange 123 and extends through an opening in a corner of the flange 124. A nut 126 is threaded onto each stud 125 for securely clamping the body sections 63, 64, 65 and 66 together.

The cover section 66 is hollow and has a threaded boss 127 in which an adjusting screw 128 is mounted. A cup-shaped washer 129 is engaged by the lower end of the screw 128 and receives the upper end of a compression spring 130, the lower end of which is engaged with the piston 119. The purpose of the screw 128 is to vary the force that may be exerted by the spring 130 to meet various installation requirements, it being understood that the screw 128 may be omitted if desired and a calibrated spring of predetermined force characteristics used.

The intermediate wall 112 in the section 65 provides an upper chamber 131 and a lower chamber 132. A threaded opening 133 communicates with the chamber 131 and has a conventional fitting 134 mounted therein which is connected to one end of the conduit 13 leading from the inlet chamber of the check valve 1. A similar threaded opening 135 communicates with the lower chamber 132 and has a fitting 136 mounted therein which is connected to one end of the conduit 14 leading from the inlet of the check valve 2.

Pressure fluid communicated to the chamber 131 through the conduit 13 will act upon the valve stem through the diaphragm 117, in opposition to the force of the spring 130, and tend to move the valve stem 78 in a direction to close the relief valve 12 or to maintain it closed. On the other hand, pressure fluid communicated to the chamber 132 through the conduit 14 will act on the valve stem 78 through the diaphragm 110 and tend to move the valve stem 78 in a direction to open the relief valve 12. It will be noted that the pressure in the chamber 132 is supplemented by the force of spring 130 in tending to open the relief valve 12.

The force exerted by the spring 130 is preferably such that a pressure differential of only 2 pounds or less in the chambers 131 and 132 will cause the relief valve 12 to open and thereby effect drainage of any liquid in the zone Z, as will be explained more fully hereinafter. In this connection, the cover section 66 is vented to the atmosphere through openings 137, so that atmospheric pressure acts upon the upper side of the piston 119 and on the diaphragm 117 against the hydraulic pressure in chamber 131. Similarly, atmospheric pressure acts upon

the lower surface of the piston 105 and diaphragm 110 through the vent openings 104, against the hydraulic pressure in the chamber 132. The wall 75 of the section 63 has vent openings 138 which communicate the inlet pressure of the relief valve 12 to the lower side of the clamping disc 102 and the diaphragm 101. Atmospheric pressure is effective upon the upper side of the diaphragm 101 through the vent openings 104.

The vent openings 104 and 137 serve the additional purpose of enabling malfunctioning of the unit to be detected. Thus, if either the diaphragm 101 or 110 should leak, water could escape from the chamber 103 through the vents 104, thereby indicating that one or the other of the diaphrams requires repair. Similarly, the vent openings 137 would indicate leakage past the diaphragm 117. A further indication of leakage is provided by the presence of a radial passage 138*a* in the wall 112, this passage extending from the spacer opening 113 to the exterior of the section 65. A seal against leakage through the passage 138*a* is normally effected by conventional O-rings 139 surrounding the spacer 114.

The fixed (or adjusted) force exerted by the spring 130 is preferably 3 p.s.i. plus or minus ½ p.s.i. difference in pressure between chambers 132 and 131. The effective areas of the diaphragms 110 and 117 are equal. The effective area of the diaphragm 101 is equal to the effective area at the seat 72. Thus, the hydraulic forces can be virtually balanced, and the spring load becomes the major factor tending to open the relief valve 12.

The design of the relief valve 12 is such that when operating as a component of a backflow unit, it will normally remain in a closed position so long as the difference in the pressures at the inlet of the check valve 1 and in the zone Z between the two check valves 1 and 2, exceeds 2 p.s.i.. If the pressure differential drops to 2 p.s.i. the relief valve 12 will open, and continue to open wider should the pressure in the zone Z decrease relative to the pressure at the inlet side of the check valve 1.

In the normal operation of the present backflow unit, check valves 1 and 2 will be open and relief valve 12 will be closed, as shown in FIG. 3. The check valve 1 by itself would reduce the supply pressure by a predetermined amount, for example, about 4½ p.s.i. at 100 g.p.m. (see FIG. 12). The check valve 2 also reduces the pressure, but in a lesser amount. At a flow rate of 100 g.p.m. check valve 2 by itself would reduce the pressure about 2.2 p.s.i. However, the check valves in combination in the unit produce an over-all pressure drop of only about 6.5 at the 100 g.p.m. flow rate. During normal flow, and at cessation of flow, the pressure in the zone Z between the check valves 1 and 2 will be less than the supply main pressure. Moreover, it will be understood that the check valves 1 and 2 open only sufficiently to supply the existing demand.

Under static conditions, both check valves 1 and 2 are positively held closed by the extreme power, made available through the spring-actuated toggle lever system incorporated therein, which increases as the linkage approaches a straight line. Should the spring 54 fail, the gravity effect of the hinge 35, links 34, lever 45 and yoke 49 will move the valve disc 24 into firm engagement with the seat 18. Also, the pin 38 is so located that even without the pressure of the toggle mechanism, the disc 24 would seat by gravity due to the offset mounting and weight of the hinge 35. It will be apparent that the force of the spring 54 acts in the same general direction as the force of gravity, i.e. in a direction away from the cover 56.

Assuming that the pressure in the supply main 6 drops to a value below that of the pressure in the service pipe 10 (due to excessive demand by others), the check valves 1 and 2 will automatically close tightly. Under these conditions, the relief valve 12 will be wide open. Normally, both check valves 1 and 2 will remain closed until the pressure conditions are reversed, thereby preventing backflow through the unit. On these conditions, the relief valve 12 will also be wide open thereby causing the space between the two check valves to be at atmospheric pressure.

On the other hand, if the check valve 2, which is nearest to the service pipe 10, should leak at this time, any such leakage would discharge directly to atmosphere through the relief valve 12. The relief valve opens when the pressure in the zone Z rises to within about 2 p.s.i. of that in the supply main 6, and such pressure is communicated through the conduit 14, FIG. 4, to the pressure chamber 132 and augments the force of the spring 130 to flex the diaphragm 110 downwardly, with a corresponding shifting of the stem 78 in the same direction, thereby urging the valve disc 84 from its seat 88 to effect opening of the relief valve 12 and venting of the zone Z to the atmosphere. Upon restoration of an increased pressure in supply main 6, this will be communicated to pressure chamber 131 to act upon diaphragm 117 to overcome the force of spring 130 and close the valve 12.

The relief valve 12 thus opens automatically in the event that the check valve 2 leaks, thereby positively preventing backflow through the unit. The discharge of water from the relief valve 12 will also indicate that the check valve 2 is not functioning properly and requires attention.

If the pressure drop in the supply main 6 is such that a vacuum condition occurs therein, this would tend to cause back-siphoning of water into the main 6. This is dangerous and highly undesirable and is avoided by the present unit in that any lowering of the pressure on the inlet side of the check valve 1 below atmospheric pressure will be communicated through the conduit 13 to the chamber 131 of the relief valve 12, lowering the pressure therein, and enabling the pressure in the chamber 132, augmented by the force of the spring 130, to automatically open the relief valve 12 to drain the zone Z, and thereby prevent water from being drawn past check valve 1, even if it should have a tendency to leak. Upon a reversal of the pressure conditions, an increase in pressure in the supply main 6 will close the relief valve 12, as above described.

FIG. 11A shows a modification of the seat shown in FIG. 11, wherein the cylindrical surface 87 is replaced by an inclined surface 87*a* extending on an angle of about 5°, as shown. In addition, the angular surface 89 is replaced by an angular surface 89*a*, also disposed on an angle of about 5°, as shown. The angular surfaces 87*a* and 89*a* are connected by a surface on a small radius (1/32"), the same dimension as the radius at the edge of the seat ridge in FIG. 11. The ridge is preferably of the same height (1/16") in both seats.

It will be understood that while the present backflow unit has been described as operating under certain prescribed pressure conditions, the functional advantages thereof can be obtained by operating under other pressure conditions, within limits, of course.

It will also be understood that the size, shape and arrangement of the elements of the check and relief valves may be varied from that disclosed herein, without departing from the principles of the invention or the scope of the annexed claims.

We claim:

1. A backflow prevention unit adapted to be connected between a supply main and a service pipe, comprising: a first check valve and a second check valve, said check valves being connected in series and being constructed to provide for straight-through, substantially unobstructed fluid flow therethrough when fully open, said first check valve having an inlet adapted to be subjected to the pressure in said supply main, and said second check valve having an outlet adapted to be subjected to the pressure in said service pipe; a differential pressure relief valve communicating with said check valves at a zone includ-

ing the outlet of the first check valve and the inlet of the second check valve for effecting draining of said zone; and means controlling said relief valve, including a pair of diaphragm elements responsive to the differential pressure across said first check valve, one of said diaphragm elements having one face thereof subject to the pressure at the inlet side of said first check valve to flex the same in one direction and the other of said diaphragm elements having one face thereof subject to the pressure at the inlet of said second check valve to flex the same in the opposite direction, the other face of both diaphragm elements being subject to atmospheric pressure, said differential pressure responsive means being effective to open said relief valve when the pressure at the inlet side of the first check valve is less than the pressure at the inlet side of said second check valve, or if the pressure at the outlet side of said second check valve is greater than the pressure at the inlet side of the first check valve and the second check valve is leaking.

2. A backflow prevention unit as defined in claim 1, in which the relief valve comprises a body having a pair of pressure chambers defined in part by the diaphragm elements; means connecting one of said pressure chambers with the inlet side of the first check valve to transmit pressure therefrom to said one face of said one diaphragm element; means connecting the other pressure chamber with the inlet side of the second check valve to transmit pressure therefrom to said one face of said other diaphragm element; a flow-control element; a stem connected with said diaphragm elements and said control element for controlling the flow through said relief valve; and means exerting a predetermined force continuously biasing said stem toward valve opening position.

3. A backflow prevention unit as defined in claim 2, wherein the relief valve includes means for preventing the flow control element from being sucked toward closing position by the action of liquid flowing from said zone discharging through the relief valve.

4. A backflow prevention unit as defined in claim 1, in which the diaphragm elements of the relief valve are of substantially equal area and said relief valve is spring-loaded to effect opening thereof when the differential pressure drops to about two pounds per square inch or less.

5. A backflow prevention unit, as defined in claim 1, in which each of said check valves includes a pivotally mounted valve disc that can be moved by line pressure to a full open position in which it offers little resistance to flow of fluid through the unit.

6. A backflow prevention unit, as defined in claim 1, in which the first check valve is preloaded to produce a predetermined pressure drop in the unit at a given flow rate through the first check valve, and wherein the second check valve is preloaded to produce a lesser predetermined pressure drop therethrough at the same flow rate.

7. A backflow prevention unit as defined in claim 1, in which the first check valve includes a pivotally mounted valve disc and means for exerting a force tending to maintain said first check valve closed, and wherein the second check valve includes a pivotally mounted valve disc and means for exerting a relatively lower force tending to maintain said second check valve closed.

8. A backflow prevention device as defined in claim 7, in which the means for exerting the force tending to maintain at least one of the check valves closed includes a toggle lever mechanism, and a spring acting on said toggle lever mechanism urging the same toward a straight-line attitude.

9. A backflow prevention device, as defined in claim 8, wherein at least said one check valve includes means for preventing the toggle lever mechanism from assuming a straight-line attitude.

10. A check valve, comprising: a body having an inlet and an outlet, said inlet and outlet being aligned on a generally horizontal axis; a seat in said body between said inlet and outlet, and arranged at substantially a right angle to said horizontal axis; a valve disc engageable with said seat; means pivotally supporting said valve disc in said valve body; a toggle lever mechanism in said valve body pivotally connected at one end thereof with said valve disc supporting means and at the other end thereof with said body, and including a link and a lever interconnected by a pin and arranged to move in a generally vertical plane to pivot said valve disc into and out of engagement with said valve seat; said toggle lever mechanism being further arranged to be operable by gravity to urge said disc into engagement with said seat; a freely oscillatable yoke pivotally connected with said pin; and a compression spring having one end engaged with said yoke and its opposite end received within a seat in said body, said spring being arranged to provide a force acting on said yoke continuously tending to straighten said toggle lever mechanism, the force of gravity and said compression spring force being the only forces tending to straighten said toggle lever mechanism, and said valve disc being arranged to be opened against said spring and gravity forces by fluid pressure in said inlet.

11. A check valve, as defined in claim 10, in which the yoke has a tapered upper end disposed within the spring to provide clearance between the yoke and the spring, whereby to avoid excessive lateral deflection of the spring as the toggle lever mechanism pivots during opening and closing movement of the valve disc.

12. A check valve, as defined in claim10, wherein the yoke carries stop elements and the valve body includes abutment means engageable by said stop elements for limiting the opening movement of said valve disc under line pressure.

13. A check valve, comprising: a body having an inlet and an outlet, said inlet and said outlet being aligned on a generally horizontal axis; a valve seat located between said inlet and outlet, and arranged generally vertically and at substantially a right angle to said horizontal axis; a valve disc engageable with said seat; means pivotally supporting said valve disc for movement from its vertical position to an approximately horizontal position to provide substantially unobstructed, straight-through flow from said inlet to said outlet; a toggle lever mechanism; means pivotally connecting one end of said toggle lever mechanism with said valve disc supporting means; and means pivotally connecting the other end of said toggle lever mechanism to said body, said toggle lever mechanism comprising a pair of links interconnected by a pivot pin that always lies above a plane passing through the means pivotally connecting said toggle lever mechanism with said valve disc supporting means and said body, respectively, said toggle lever mechanism being operable at all times by gravity to normally urge said valve disc toward its seat and being actuatable to hold said valve disc in engagement with said seat; and actuating means connected with said toggle lever mechanism acting in the same direction as gravity for applying a straightening force thereto in addition to the force provided by gravity to urge said valve disc toward its seat.

14. A check valve as defined in claim 13, wherein the seat is metallic and has a laterally extending marginal flange and the valve disc is yieldable and has a metallic retainer associated therewith provided with a rim engageable with said flange, said flange and rim normally being spaced apart when the valve is fully closed, said rim being engageable with said flange under excessive wear or compression of said valve disc to provide metal-to-metal contact, said toggle lever mechanism being proportioned so that said metal-to-metal contact is made to prevent the toggle lever mechanism from assuming a straight-line attitude.

15. A check valve comprising: a body having an inlet and outlet arranged in alignment on a generally horizontal axis; a seat mounted in said inlet and extending at right angles to said horizontal axis thereof; a valve disc

engageable with said seat; a hinge member pivotally connected by a first pin with said valve disc; a link having one end connected with said first pin; a lever in said body having one end pivotally connected with said valve body by a second pin; a third pin pivotally connecting the other end of said lever with the other end of said link, said lever and said link being arranged to move in a generally vertical plane and being operable by gravity to urge said valve disc toward its seat and being actuatable to hold the said disc in engagement with said seat; a freely oscillatable yoke, pivotally connected with said third pin; and a spring engaged with said yoke acting in the same direction as said force of gravity, and tending to move said third pin toward alignment with said first and second pins, the force of gravity and the force of said spring being the only forces tending to move said lever and said link to engage said disc with said seat.

16. A check valve as defined in claim 15, wherein the distance between the axes of said second and third pins is slightly less than about four times the distance between the axes of said first and third pins.

17. A pressure differential operable valve, comprising: a body having an inlet and an outlet and a seat between said inlet and outlet; a valve disc engageable with said seat on the discharge side of said seat for controlling flow therethrough; a valve stem connected with said valve disc and extending through said seat; means including diaphragms of equal areas and a wall between said diaphragms providing a pair of adjacent pressure chambers; means connecting said diaphragms with said valve stem, said valve body including openings for admitting operating fluid into the respective pressure chambers, said diaphragms being arranged so that operating fluid effective on one diaphragm will move the valve stem upwardly toward valve closing position, and operating fluid effective on the other diaphragm will move the valve stem downwardly toward valve opening position; means for venting leakage past said diaphragms to the atmosphere; and a spring in said valve body acting on said valve stem and tending to move the same downwardly toward valve opening position.

18. A valve as defined in claim 17, wherein the valve seat includes means for preventing fluid discharging through the seat from sucking the valve disc toward the seat.

19. A valve as defined in claim 17, in which the seat includes a raised ridge engageable by the valve disc, and wherein the ridge is defined by an arcuate surface originating at the seat opening and merging into an outwardly flaring surface disposed on an angle of about 25° to the axis of the seat, whereby to prevent discharging fluid from producing suction tending to draw the valve disc toward said seat.

20. A pressure differential operable valve, comprising: a body having four sections, the first section having an inlet and an outlet and a valve seat between said inlet and outlet; a valve disc engageable with said seat; a valve stem connected with said valve disc; a second section disposed adjacent said first section and having a central opening formed therein to receive said valve stem; a first diaphragm extending across said central opening and being connected with said valve stem; a third section disposed adjacent said second section and including a transverse wall providing a chamber for fluid pressure on the opposite sides thereof, said stem extending through said transverse wall; a fourth section adjacent said third section; a second diaphragm arranged between said second and third sections; a third diaphragm arranged between said third and fourth sections; means connecting said valve stem with said second and third diaphragms, said second and third diaphragms cooperating with the wall of said third section to provide a pair of pressure chambers, said third section having means for simultaneously introducing operating fluid under pressure into said pair of pressure chambers, whereby any differential pressure present will be effective to move said valve stem in one direction or the other to open or close the valve; and a compression spring in said fourth section acting upon said valve stem to move the same toward valve opening position.

21. A valve as defined in claim 20, in which the effective area of the seat or valve disc and the effective area of the first diaphragm are substantially equal, and wherein the effective area of the second and third diaphragms is substantially equal.

22. A check valve, comprising: a body having an inlet and outlet aligned on a generally horizontal axis; a seat mounted in said inlet and extending at right angles to said horizontal axis thereof; a valve disc engageable with said seat; a hinge member pivotally mounted in said body and being pivotally connected by a first pin with said valve disc; a link having one end connected with said first pin; a lever in said body having one end pivotally connected with said body by a second pin; a third pin pivotally connecting the other end of the lever with the other end of the link, said lever and said link being arranged to move in a generally vertical plane and being operable by gravity to urge said valve disc toward its seat and being actuatable to hold said disc in engagement with said seat; a freely oscillatable yoke pivotally connected with said third pin; a compression spring telescopically engaged at one end thereof with said yoke and acting in the same direction as said force of gravity to actuate said third pin toward alignment with said first and second pins, said body having an opening affording access to said valve disc, link, lever, yoke and spring; and a cover overlying said opening and having a recess therein receiving the other end of said spring.

23. A check valve as defined in claim 22, wherein the body has opposed side walls and an aligned pair of bosses on said side walls respectively receiving the ends of the second pin.

24. A check valve, comprising: a body having an inlet and outlet aligned on a generally horizontal axis; a seat mounted in said inlet and extending at right angles to said horizontal axis; a valve disc engageable with said seat; a hinge member pivotally mounted in said body and pivotally connected by a first pin with said valve disc; a link having one end connected with said first pin; a lever in said body having one end pivotally connected with said body adjacent said outlet by a second pin; a third pin pivotally connecting the other end of the lever with the other end of the link, said lever and said link being arranged to move in a generally vertical plane and being operable by gravity to urge said valve disc toward its seat and being actuatable to hold said disc in engagement with said seat; a freely oscillatable yoke pivotally connected with said third pin; and a spring engaged with said yoke acting in the same direction as said force of gravity to actuate said third pin toward alignment with said first and second pins, the axes of said first and third pins lying upon longitudinal lines parallel with the axis of said inlet and in planes below a longitudinal line passing through the axis of said second pin when said valve disc is in closed position, and said third pin being disposed on a line parallel with said inlet axis and above longitudinal lines passing through the axes of said first and second pins when said valve disc is in its fully open position.

25. A check valve as defined in claim 24, in which a cover is mounted upon the body and wherein the cover has a recess and one end of the compression spring is received in said recess.

26. A check valve as defined in claim 24, wherein the third pin is substantially vertically aligned with the axis of the compression spring when the valve disc is in its fully open position.

27. A check valve as defined in claim 24, in which a cover is mounted upon the body and wherein the cover has a recess and one end of the compression spring is received in said recess; and wherein the third pin is substan-

tially vertically aligned with the axis of the compression spring when the valve disc is in its fully open position.

28. A check valve comprising: a body having an axially extending inlet opening and an outlet opening in alignment therewith on a generally horizontal axis; a valve seat mounted in said inlet opening and disposed at right angles to said horizontal axis; a valve disc engageable with said seat; a hinge member mounted within said valve body and pivotally supporting said valve disc; a toggle device including a link having one end thereof pivotally connected with said hinge member and a lever having one end thereof mounted within and pivotally connected with said valve body and having its other end pivotally connected with the other end of said link, said link and said lever being movable in a vertical plane and being arranged to be operable by gravity to urge said disc into engagement with said seat; a freely oscillatable yoke pivotally connected with said link and lever; and a compression spring in said valve body engaged with said yoke acting in the same direction as gravity, and tending to

straighten said toggle device, the force of gravity and the force of said spring being the only forces tending to seat said valve disc, said disc being arranged to be opened against said gravity and spring forces by fluid pressure in said inlet.

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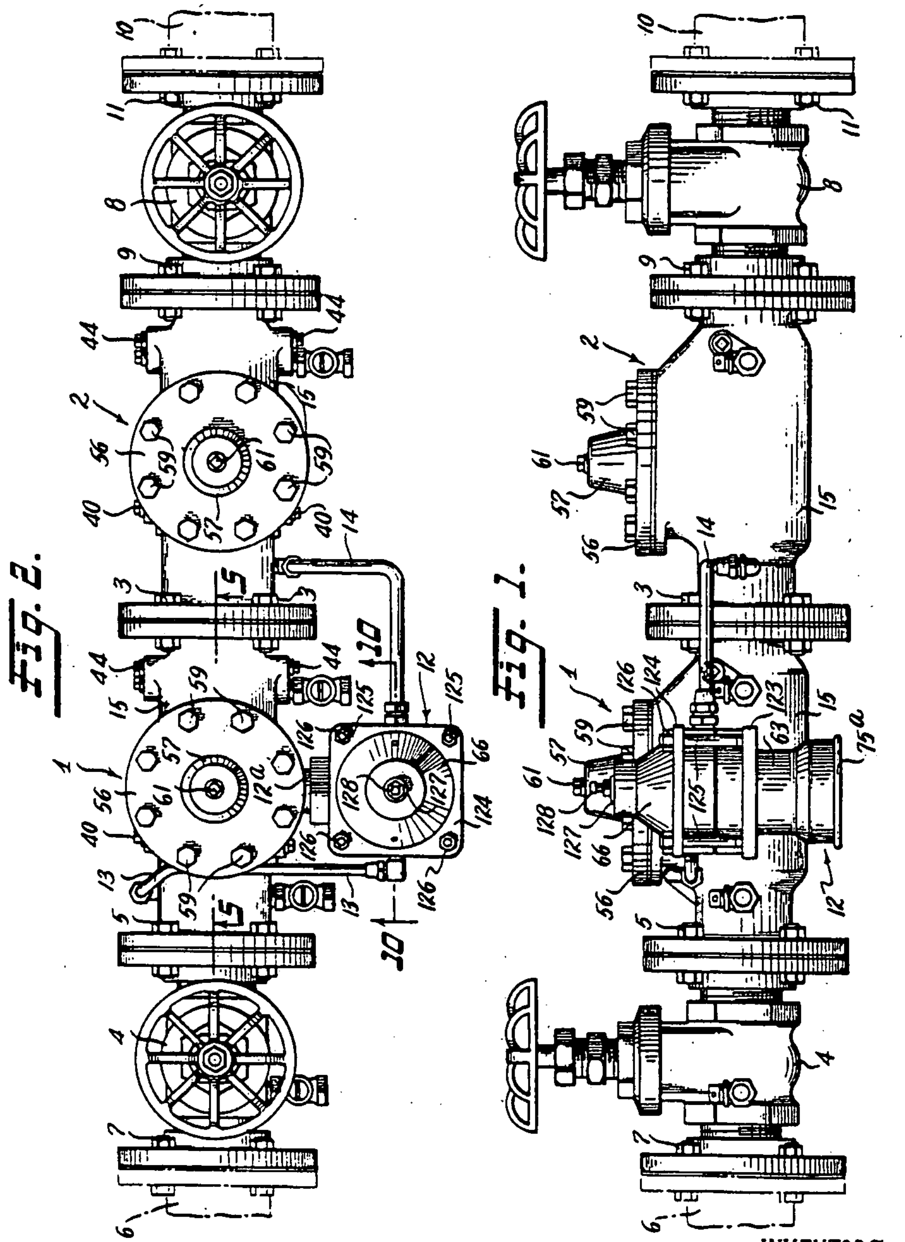
BACKFLOW PREVENTION DEVICE

Filed June 26, 1961

6 Sheets-Sheet 1



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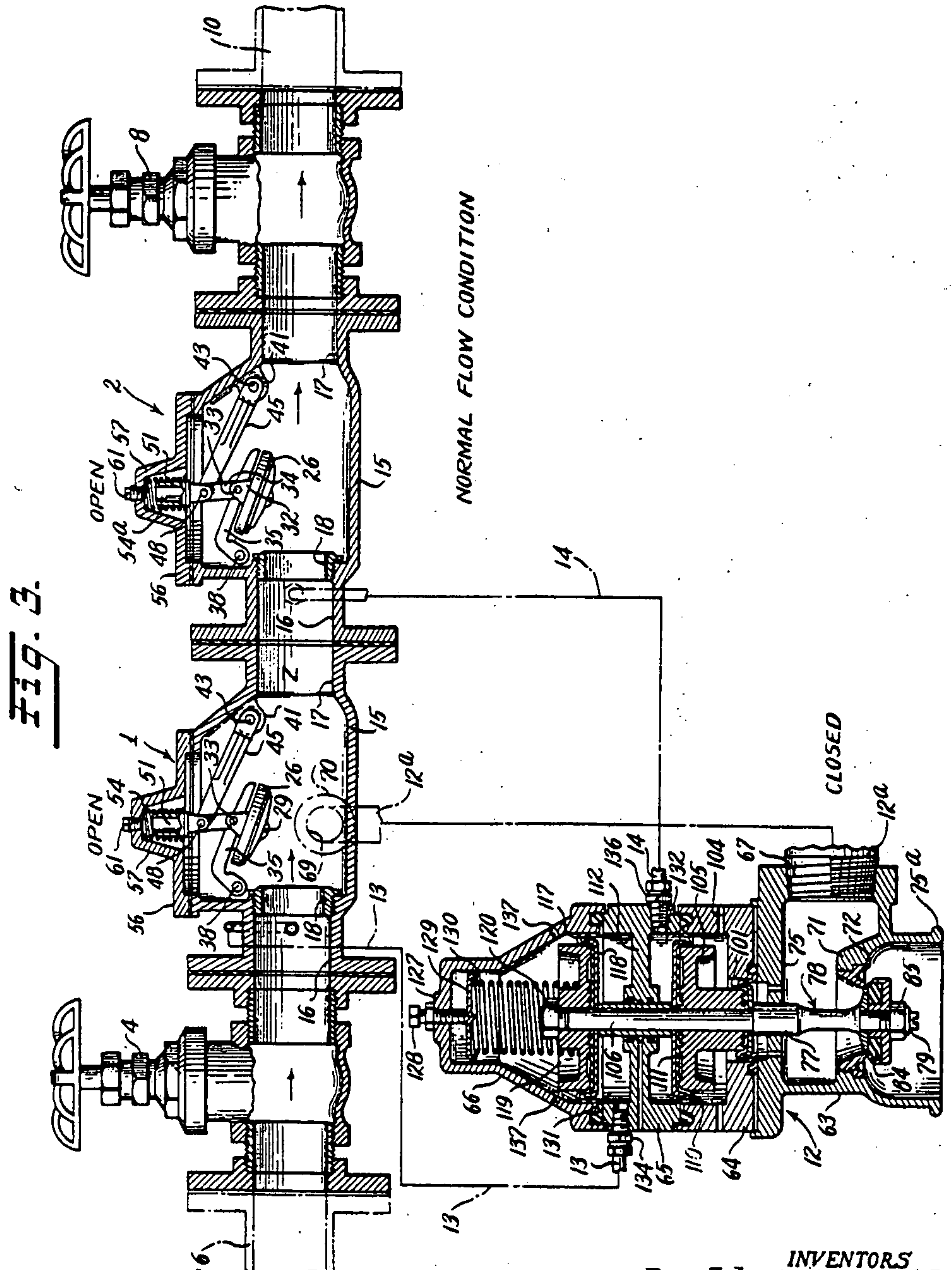
BACKFLOW PREVENTION DEVICE

Filed June 26, 1961

6 Sheets-Sheet 2

FIG. 3.



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BACKFLOW PREVENTION DEVICE

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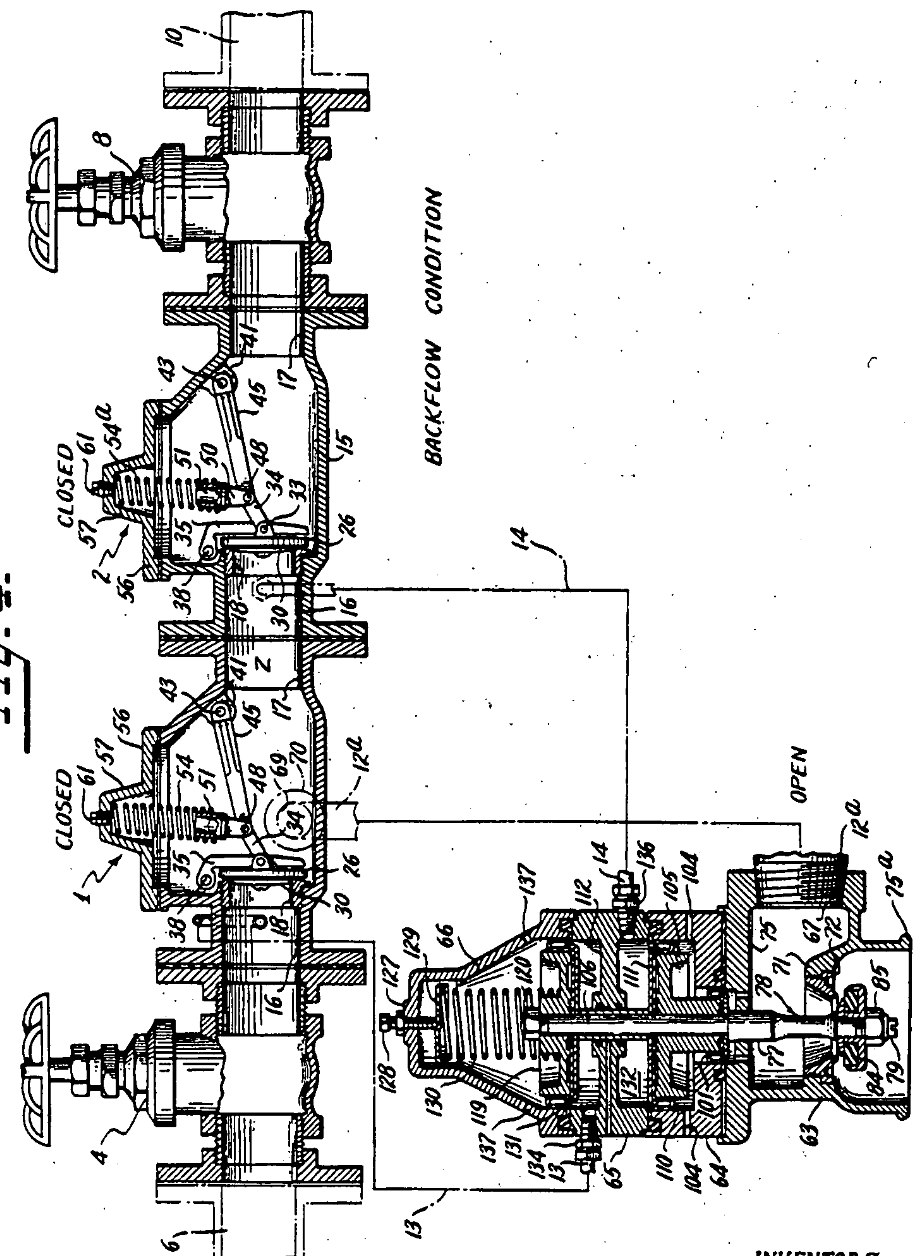

Fig. 4.

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BACKFLOW PREVENTION DEVICE

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Fig. 5.

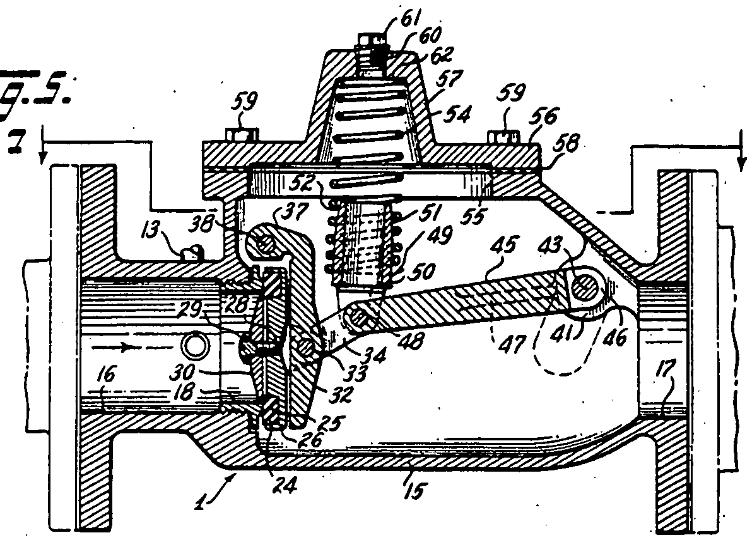


Fig. 7.

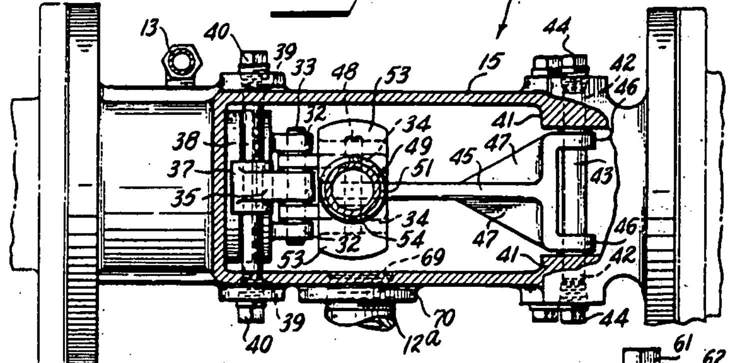
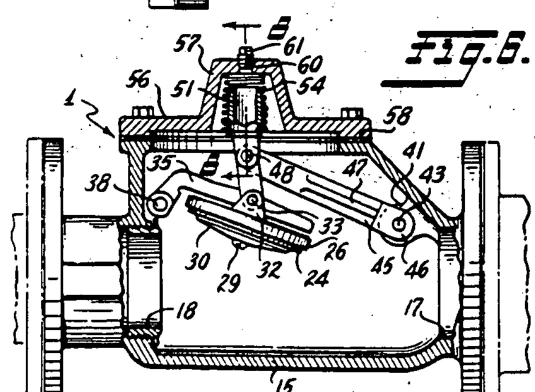


Fig. 6.



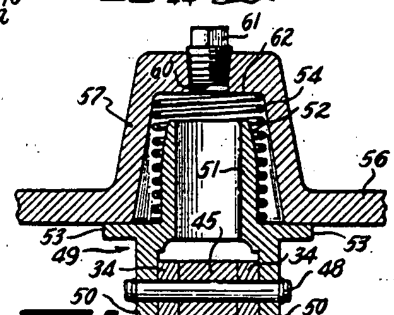


Fig. 8.

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Fig. 10.

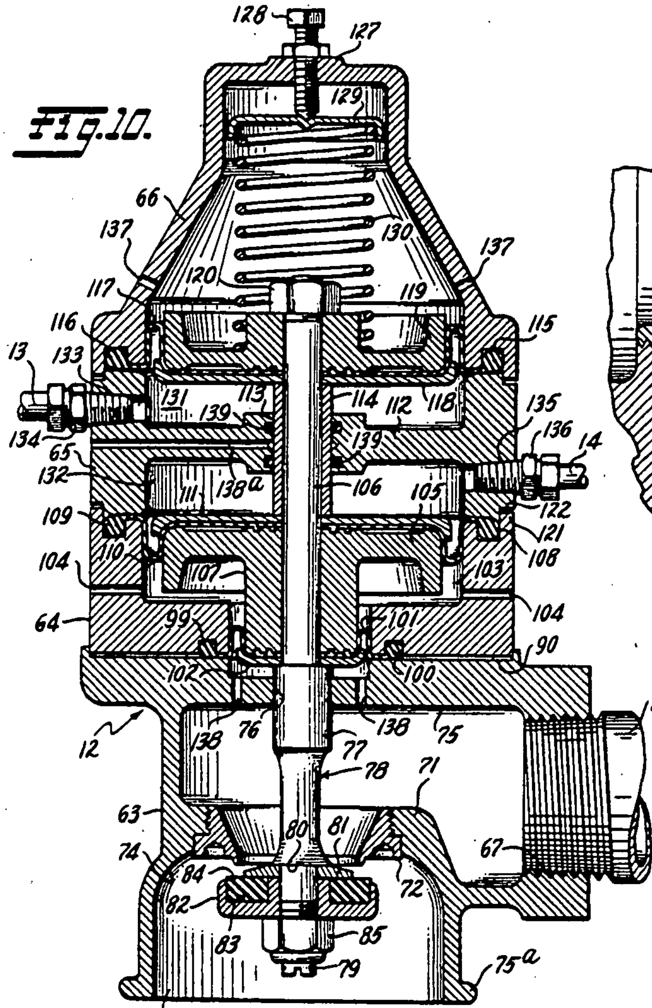


Fig. 9.

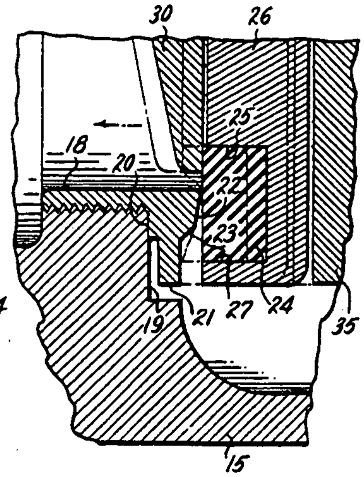
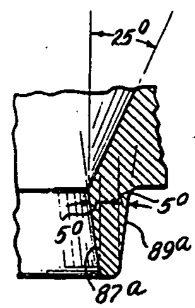


Fig. 11A.



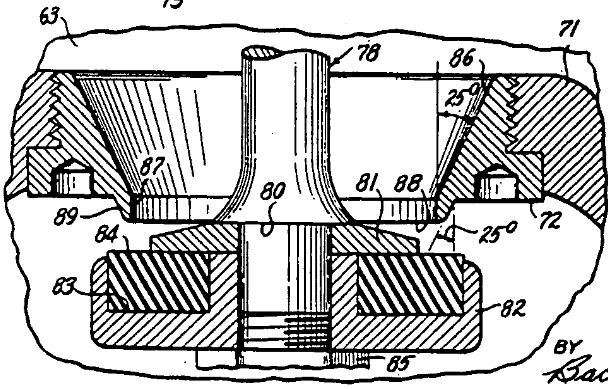


Fig. 11.

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BACKFLOW PREVENTION DEVICE

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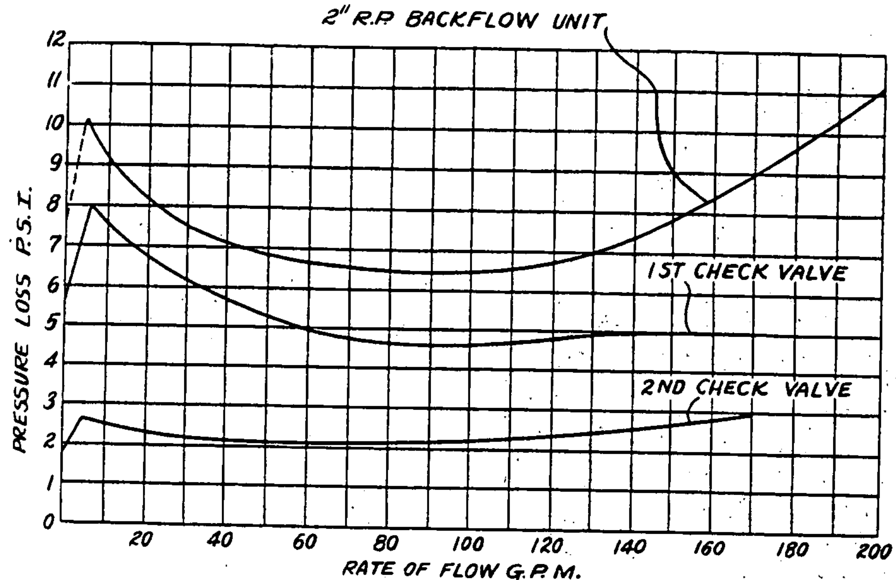

Fig. 12.

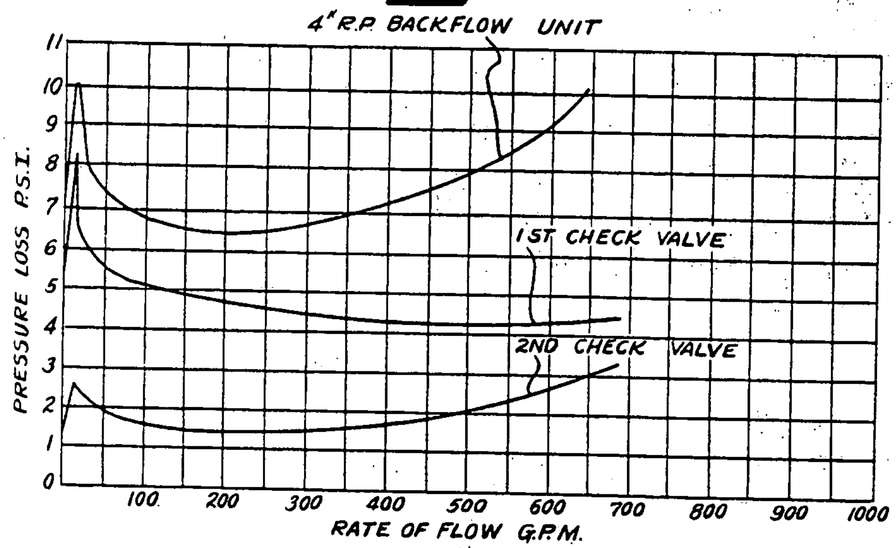

Fig. 13.

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United States Patent Office

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POLYJET VALVE

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Int. Cl. F16k *1/06*

U.S. Cl. 137—219 7 Claims

ABSTRACT OF THE DISCLOSURE

A polyjet valve for throttling hydraulic flow includes a housing having a liquid inlet and a liquid outlet. A tube of circular cylindrical form is disposed within the housing and at one end is interiorly connected to the outlet. The other end of the tube is closed. The tube is pierced by an exceptionally large number of holes. The relationship of these holes is determined by the formulas:

$$D_H = \frac{\text{from } 0.2 \text{ to } 0.4 ID_T}{12}$$

wherein D_H is the diameter in inches of a typical hole and ID_T is the diameter of the tube in inches and

$$H_S = \text{from } 2.0 \text{ to } 3.5 D_H$$

wherein H_S is the center to center distance of adjacent holes. The tube wall thickness is between 1.0 and 2.0 times the hole minimum diameter. The holes in the aggregate have a flow area approximately equal to the flow area through the tube. A solid sleeve in the housing and surrounding the tube on the high pressure side is relatively movable along the tube by means operable from outside the housing.

Our invention relates to the control of the flow of hydraulic fluid, usually water, in a pipeline and is particularly concerned with controlling flow in a pipeline wherein the pressure of the incoming liquid must be substantially reduced in the valve in order to be discharged at a considerably lower pressure.

Valves of this sort are utilized in water projects; for example, in the Central Valley Project in California where at numerous locations water which has been pumped to the top of a relatively high mountain must be brought down the other side of the mountain to a low elevation and must have its pressure substantially reduced in descending in order that it not burst the pipeline nor issue from the pipeline with a destructive force. Presently known valves for this purpose can accommodate only a relatively small pressure drop between valve inlet and valve outlet necessitating the use of a large number of valves in series in order to attain the desired total pressure drop. In some instances where large pressure drops per valve have been attempted, the valves have had extremely short lives because the water in flowing through the valve cavitates and destroys the valve material. In a surprisingly short time the valve is no longer serviceable. Also, the cavitation is attended by a loud noise so such valves cannot be used near dwellings. Alternatively, some energy absorbers have been considered as reducers but these, too, are subject to cavitation and do not lend themselves to a variable pressure drop which is greatly preferred. There is a need in this particular field for a valve providing a much larger than usual pressure drop yet not subject to cavitation and early destruction and able to vary from time to time its pressure reducing capacity.

It is therefore an object of the invention to provide an improved valve.

Another object of the invention is to provide a valve effective to produce a relatively great pressure drop through the valve yet not subject to any appreciable or

substantial cavitation and, hence, having a relatively long life.

Another object of the invention is to provide a valve of the described sort which can be varied from time to time in its capacity.

A further object of the invention is to provide a valve of the sort described which, while perhaps somewhat more expensive than usual to make, is still less expensive than a series of other types of valve for the same pressure drop.

A further object of the invention is to provide a throttling valve which can easily be controlled.

A still further object of the invention is to provide a valve which can readily be inspected and repaired if necessary.

A further object of the invention is to provide a valve of improved characteristics that can be fabricated with ordinary materials and facilities.

Other objects together with the foregoing are attained in the embodiments of the invention described in the accompanying description and illustrated in the accompanying drawings, in which:

FIG. 1 is a cross-section on an axial plane through one form of valve constructed pursuant to the invention;

FIG. 2 is an enlarged detail in cross-section, the plane being the same as in FIG. 1;

FIG. 3 is an enlarged detail showing in development the preferred form and pattern of holes in the tube; and

FIG. 4 is a cross-section on an axial plane through a modified form of valve pursuant to the invention.

For one particular installation a valve pursuant to the disclosure has been fabricated as especially illustrated in FIG. 1. While the figure is not exactly to scale, it is roughly true to proportion and indicates a valve having a nominal eight inch internal diameter. In this valve there is provided a housing **6** having an inlet section **7** and disposed symmetrically about a longitudinal axis **8**. The inlet section **7** extends to a point of flexure **9** at which the inlet section is joined to a diverging cone **11** leading to a body section **12** extending beyond a flanged junction **13**. The body section is substantially circular cylindrical about the axis **8** and terminates in an outwardly extending flange **14** paired with a companion flange **16** secured in place by the customary fastenings, not shown. The flange **16** is reduced in diameter and at its inner margin **17** is joined to a tube **18** having the same nominal inside diameter as the section **7**. The tube **18** is open at its downstream or outlet end and communicates with a pipe **19** leading to any suitable point of discharge.

The tube **18** is coaxial with and for the most part is disposed within the cylindrical, body section **12**. The wall of the tube **18** has an outside surface **21** parallel to the inside surface **22** of the section **12**, the distance between the surfaces **21** and **22** measured in a radial direction defining the radial thickness of an annulus having a cross-sectional area for flow which is the same as that of the inlet of the section **7**.

The upstream end **23** of the tube near the junction **13** is provided with a closure plate **24** united to the tube **18** in any suitable way, for example, by welding. The plate **24** extends radially beyond the surface **21** and is beveled to provide a conical seat **26**. In order that flow toward the closure **24** will be relatively smooth and uniform, there is provided a nose cone **27** having an approximately parabolic exterior contour. The nose cone is disposed symmetrically on the axis **8** with the tip **28** of the nose cone disposed near the flexure point **9**.

The nose cone is supported in position by a plurality of narrow fins **29** extending axially and radially. The fins **29** are positioned as close as possible to the tip **28** and extend only part way back toward the plate **24**. Any disturbance in flow due to the interposition of the fins has

plenty of room to dissipate or to be damped out before the flow passes over the seat **26**. The entrance arrangement is designed to have substantially constant cross-sectional flow area so as to disturb the velocity of flow of the incoming water as little as possible and to discourage and inhibit eddying or turbulence in the stream. As nearly as possible the incoming water tends to flow into the annular space **31** between the tube **18** and the interior of the body section **12** with practically no turbulence.

Particularly in accordance with the invention, the tube **18** is provided with an extraordinarily large number of restricted flow holes **32** therein. We have found by extended experimentation and carefully controlled tests that the objects of the invention are most nearly attained when the size (i.e. diameter, in the case of circular holes) of the holes is controlled. In the usual case, wherein all of the holes have the same nominal diameter we have found in our tests that the diameter of each hole can be determined from the following empirical formula:

$$D_H = \frac{\text{from } 0.2 \text{ to } 0.4 ID_T}{12}$$

wherein D_H is the diameter in inches of the hole, and ID_T is the diameter of the tube, such as the tube **18**, in inches. For a nominal 8 inch tube this substitutes as follows:

$$D_H = \frac{0.2\ (8\text{ inches})}{12} = 0.133\text{ inch}$$

and

$$D_H = \frac{0.4\ (8\text{ inches})}{12} = 0.266\text{ inch}$$

For discussion, this range can be approximated as averaging in the vicinity of one quarter of an inch. The thickness of the tube wall is between 1.0 and 2.0 times the minimum hole diameter.

These holes are preferably provided in a sufficient number so that the aggregate area of the holes approximates the flow area of the pipe. That is, a quarter inch hole has a flow area of 0.0491 square inch so that to provide a total flow area of about fifty square inches, corresponding to that of an eight inch diameter pipe, approximately nine hundred to a thousand holes are provided.

The location and spacing of the holes are arranged with care. The distance between any two adjacent holes is determined by the empirical formula:

$$H_S = \text{from } 2.0 \text{ to } 3.5 D_H$$

wherein D_H is as before and H_S is the distance between hole centers. For a nominal hole diameter of one quarter of an inch this substitutes as follows:

$$H_S = 2.0\ (.25\text{ inch}) = 0.500\text{ inch}$$

and

$$H_S = 3.5\ (.25\text{ inch}) = 0.875\text{ inch}$$

Furthermore, the positioning of the holes is preferably in a helical pattern so that the flow action through adjacent holes tends to be noninterfering. The point is to provide such a large number of holes that the individual holes are relatively small and are so spaced that the jet discharging from each individual hole has its energy dissipated by the shearing action of the water without the jet interacting with the jet discharge from any adjacent hole. By extensive tests it has been demonstrated (by observation with dyes, hydrophones and accelerometers and by observation of the parts after extensive use) that there is no detectable cavitation in the structure and the operation is quiet.

The holes closest to the closure **24** are not positioned immediately adjacent thereto but themselves are spaced axially downstream a distance from the barrier at least equal to four times the diameter of the holes themselves. Additionally, attention is paid to the configuration of the individual holes. Ideally, and if cost were no object, it

would be preferred to bore the holes into the wall of the tube from the outside with the axis of each hole extending radially inwardly and with the configuration of the hole approximating a venturi section. This would afford a rounded inlet, a narrow throat and a gradually diverging outlet. This construction is so expensive as to be virtually prohibitive. However, most of the advantages of such configuration can be attained by providing, as shown in FIG. 2, a configuration of each hole according to which the hole is conical with the sides of the hole converging inwardly at an angle A of about 5.75 degrees to the hole axis **33**. In providing this economical configuration it is not difficult also to provide slightly rounded inlets to the holes and thus get improved results.

While it may be well known to provide a valve tube having a few holes in it, we believe it is unique and special to provide a tube having a very large number of holes, say several hundred holes; that is to say, a tube that divides the flow through the entrance member into several hundred smaller flows for control purposes. Since the tube has so many jet perforations, we refer to a valve of this type as a "polyjet" valve. Our work shows that a construction with only a few holes in subject to substantial cavitation even at relatively small pressure drops, while our construction, as explained herein, has not yet been found subject to cavitation even at extremely large pressure drops.

The valve as so far decribed can be used in the event a constant pressure drop across the valve is desired. But there are cases wherein it is desired that the pressure drop be varied and that the valve be shut off entirely. For that reason we provide within the housing **12** and preferably slidable along the tube **18** on the upstream or high pressure side thereof a sleeve **41** coaxial with the tube and having a valve seat **42** at its upstream end. The seat **42** is designed in one extreme position to abut the seat **26** and to preclude flow therebetween. The sleeve otherwise is an imperforate cylinder having an interior relief **43** for manufacturing and operational purposes. At one end the sleeve has a ring **44** to which actutaing rods **46** are moved axially by any suitable structure **48** well known and not illustrated in detail.

In one extreme position of the sleeve **41** all of the holes **32** are uncovered and the valve operates at its maximum flow capacity. In another extreme position of the sleeve **41** all of the holes are covered and the seats **26** and **42** are in abutment so that the valve has no flow capacity. The sleeve **41** can be positioned at any intermediate location so that as many as desired of the holes are uncovered to permit the valve to operate at partial capacity.

We have found that it is essential that the control sleeve be located on the high pressure side of the tube so that the sleeve is away from the water leaving the holes and thus is not subject to any disturbances which might produce cavitation at the sleeve.

For most installations we prefer to have all of the valve parts arranged coaxially, as shown in FIG. 1, but there are instances in which a somewhat less expensive, more conventional configuration is acceptable. For that reason we provide a polyjet valve as shown in FIG. 4 having a housing **61** with a central enclosure **62** symmetrical about an axis **63**. The housing includes an inlet section **64** and an outlet section **66** axially offset with respect to each other. The housing is closed at the top or one end by a removable cap **67** secured in place by removable fasteners **68**. An operating stem **69** passes through a packing arrangement **71**. At one end the stem **69** carries an end disc **72** having a flange **73** secured by welding **74** to a valve tube **76**. For part of its length the tube, as before, is perfectly smooth and is a circular cylinder coaxial with the axis **63**. The sleeve at one end carries a packing mechanism **77** slidable on the interior finished cylindrical wall **78** of the housing **61**. The sleeve also is slidable within a seat ring tube **81** extending around the interior of the housing and tightly secured therein. The seat ring

tube 81 has a conical terminus 82 against which a similarly shaped seat band 83 secured to the solid portion of the tube 76 may abut.

The tube 76 adjacent the other end and beyond the solid portion is provided with a large number of holes 84. These holes are constructed and arranged and are present in numbers substantially as previously indicated. They are of relatively small diameter and are spaced and arranged in helical paths centered on the axis 63. Each of the holes has a configuration so that the hole wall 86 is tapered and converges inwardly toward the axis 63.

In the closed position of the valve, as shown in FIG. 4, only the solid portion of the sleeve 76 is presented to the incoming liquid within the inlet 64. As the stem 69 is raised the seat band 83 lifts from the seat ring tube 81 and the next adjacent holes 84 are uncovered. Flow is thus past the band 83 and through the tube wall from the upstream side (the high pressure side) to the downstream side (the low pressure side) and such flow discharges through the outlet 66. When the stem 69 has been fully raised all of the holes 84 are utilized to throttle the flow through the valve. Any intermediate position of the valve tube 76 can likewise be selected so that the seat ring tube 81 permits only some of the valve holes to be effective.

By actual test on advanced hydraulic test equipment it has been demonstrated that a polyjet valve constructed in accordance with the disclosure herein will successfully afford a much greater than usual pressure drop through the valve without any cavitation at all flow rates. This is evidenced partly because the valve is quiet in its ordinary operation as distinguished from the loud "singing" which ordinarily accompanies pressure drop in hydraulic valves of this sort, and also is evidenced by the fact that after protracted and accelerated wear tests the valves do not show any deleterious effects from cavitation.

Representative test results with an 8-inch (diameter) valve show that the cavitation index, sigma, is as follows:

Hole size	Hole spacing	Sigma value
.125	.401	.95-1.0
.1875	.401	1.0
.250	.570	1.15
.375	.835	1.35

wherein

$$\text{sigma}=\frac{\text{downstream head (feet)}+33}{\text{differential head across valve (feet)}}$$

What is claimed is:

1. A polyjet valve comprising a housing having a liquid inlet and a liquid outlet; a tube having a wall and disposed within said housing and interiorly connected to said outlet at one end; means for closing the other end of said tube; means defining a plurality of holes through said tube wall according to the following formula

$$D_H=\frac{\text{from } 0.2 \text{ to } 0.5\ ID_T}{12}$$

wherein D_H is the diameter in inches of a typical hole and ID_T is the diameter of said tube in inches; and according to the following formula

$$H_S=\text{from } 2.0 \text{ to } 3.5\ D_H$$

wherein D_H is as before and H_S is the center to center distance of adjacent holes; and according to the following formula

$$T_W=\text{from } 1.0 \text{ to } 2.0\ D_H$$

where D_H is as before and T_W is the tube wall thickness; and said holes in the aggregate having a flow area approximately equal to the flow area through said tube; a solid sleeve in said housing surrounding said tube on the high pressure side thereof and relatively movable along said tube; and means operable from outside said housing for moving said sleeve relative to said tube.

2. A device as in claim 1 in which said holes have inwardly converging configurations.

3. A device as in claim 1 in which said tube is circular-cylindrical about an axis, and said holes are arranged with their centers in paths helical about said axis of said tube.

4. A device as in claim 1 in which said holes are disposed substantially uniformly around and along said tube.

5. A device as in claim 1 in which said holes in said tube closest to said closing means are spaced from said closing means by a distance at least equal to four times the diameter of said holes.

6. A device as in claim 1 in which said tube has a first seat projecting radially from said tube at one end and said sleeve has a second seat at the adjacent end positioned to abut said first seat when said sleeve is in one extreme position on said tube.

7. A device as in claim 1 in which said liquid inlet, said liquid outlet, said tube, and said sleeve are all coaxial.

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U.S. Cl. X.R.

137—625.38

POLYJET VALVE

Filed Dec. 4, 1969 2 Sheets-Sheet 1

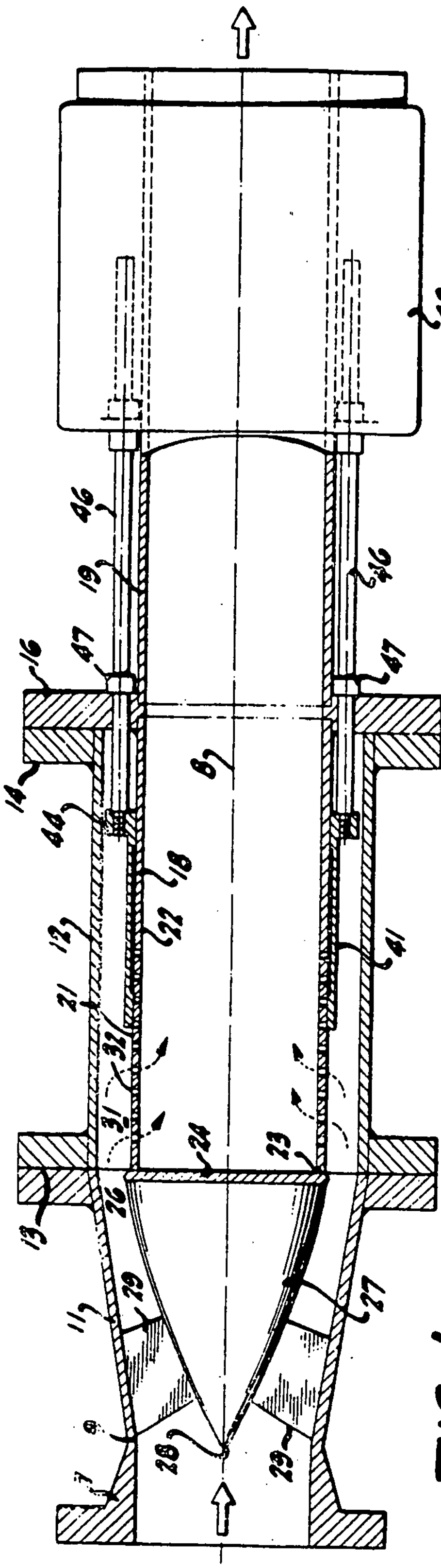

FIG. 1

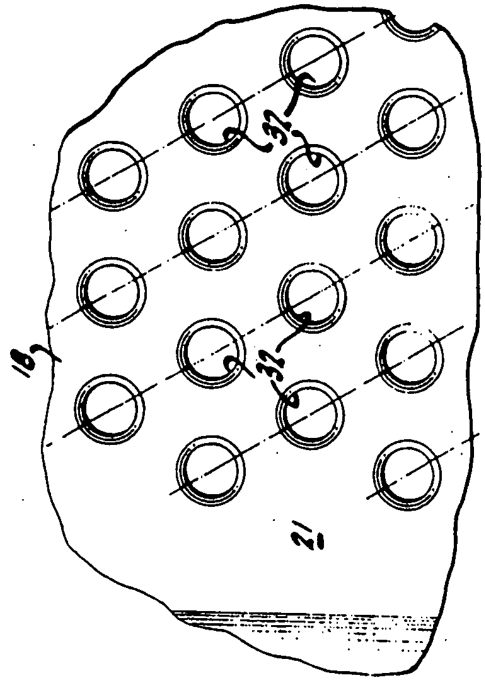

FIG. 3

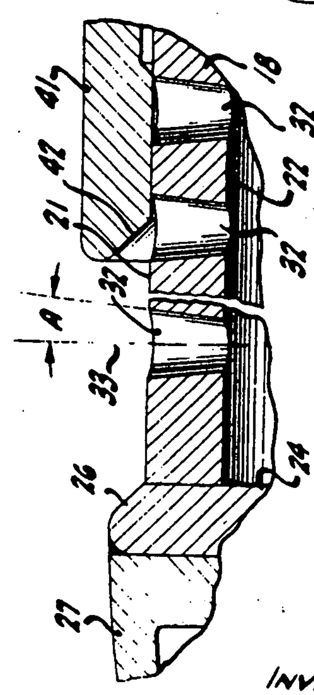

FIG. 2

INVENTORS
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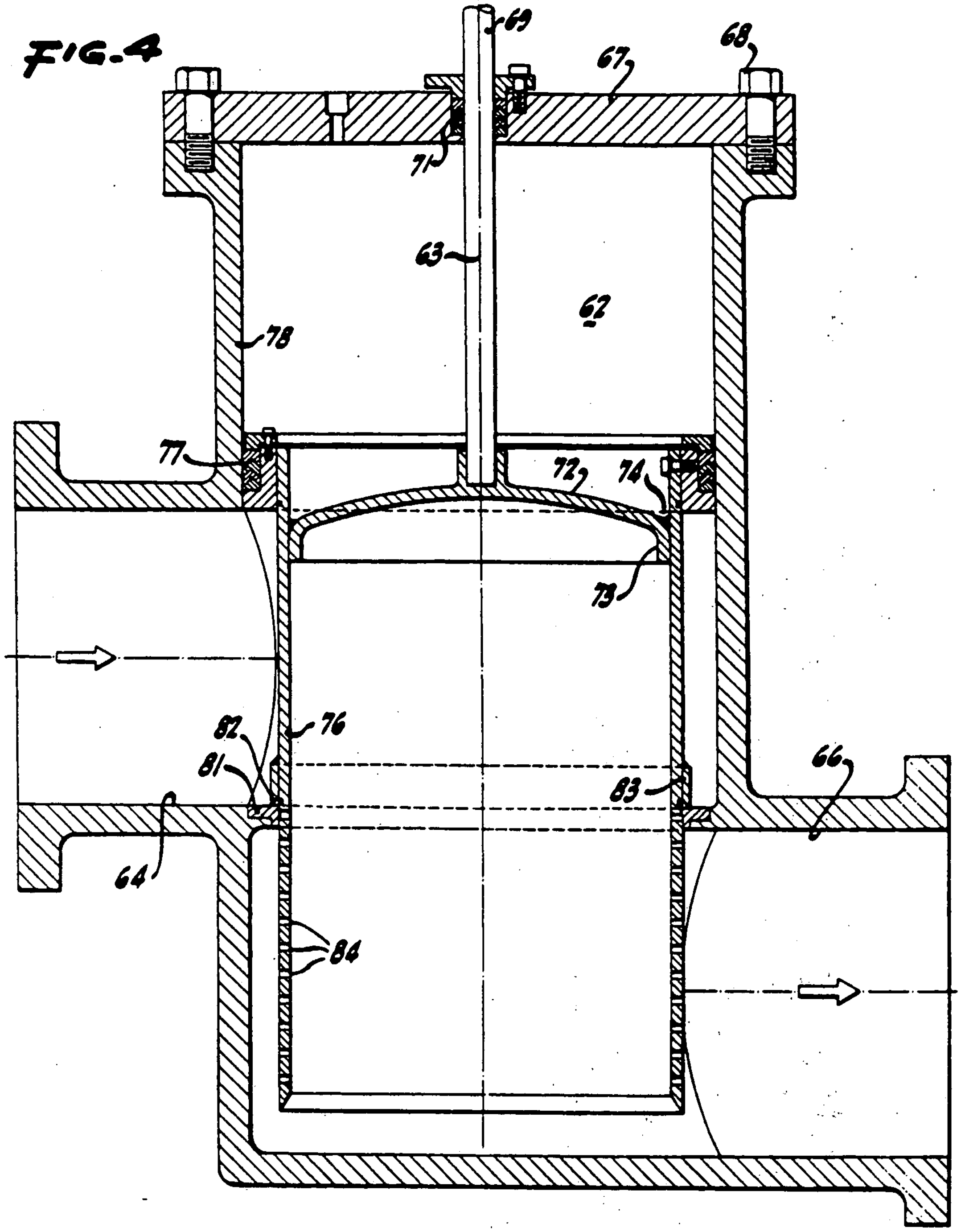
BY
Lothrop & West
ATTORNEYS

POLYJET VALVE

Filed Dec. 4, 1969 2 Sheets-Sheet 2

FIG.4



INVENTORS
RALPH J. KROGFOSS
ROBERT W. DIXON
BY
Lothrop & West
ATTORNEYS

United States Patent [19]

Hills

[11] **3,789,874**

[45] **Feb. 5, 1974**

[54] **CHANGING BIAS CHECK VALVE**

[75] Inventor: **David A. Hills**, Abington, Mass.

[73] Assignee: **Hersey Products Inc.**, Dedham, Mass.

[22] Filed: **July 13, 1972**

[21] Appl. No.: **271,625**

[52] U.S. Cl. **137/527**, 137/531, 251/303, 251/263

[51] **Int. Cl.** **F16k 15/03**

[58] **Field of Search** 137/527, 527.4, 527.6, 530, 137/531; 251/298, 299, 303, 251, 262, 263

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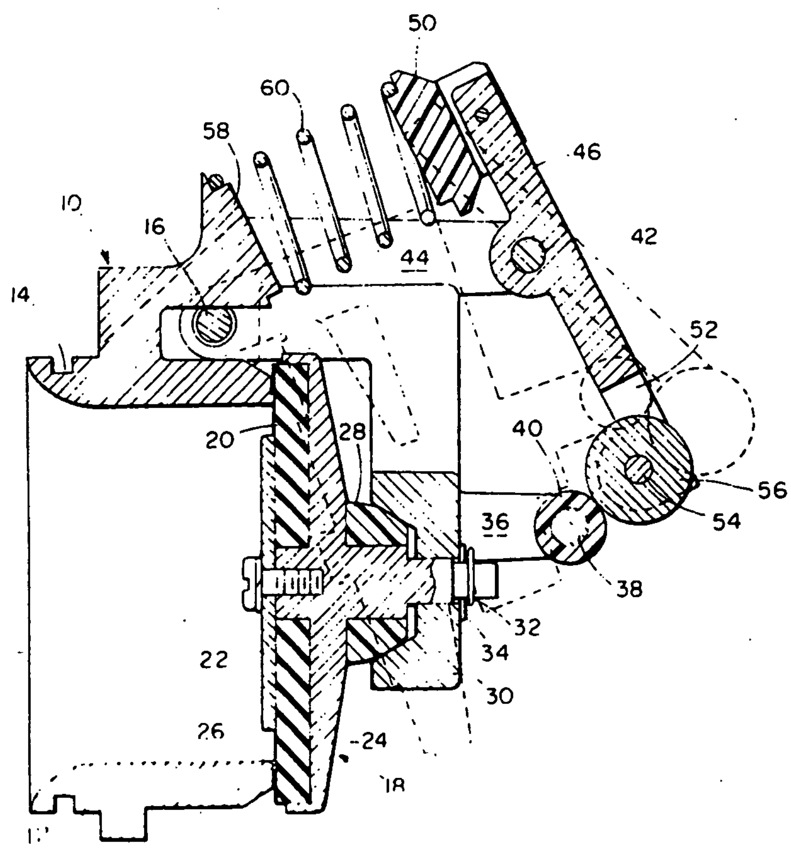
Primary Examiner—William R. Cline

[57] **ABSTRACT**

A check valve in which clapper bias torque diminishes as the clapper opens, a clapper support carrying pivotally mounted thereon a clapper assembly and (pivotally mounted intermediately thereof) a cam arm, a compression spring extending between the clapper support and one end of the cam arm causing the other end of the cam arm to impose a bias force on the clapper assembly, the bias force being imposed along a plane defined by a transverse line near said other end of the cam arm and a transverse line on the clapper assembly. In a preferred embodiment the force is imposed from a stainless steel roller rotatably mounted in said other end of the cam arm to a plastic roller rotatably mounted at the downstream end of the clapper assembly.

8 Claims, 2 Drawing Figures



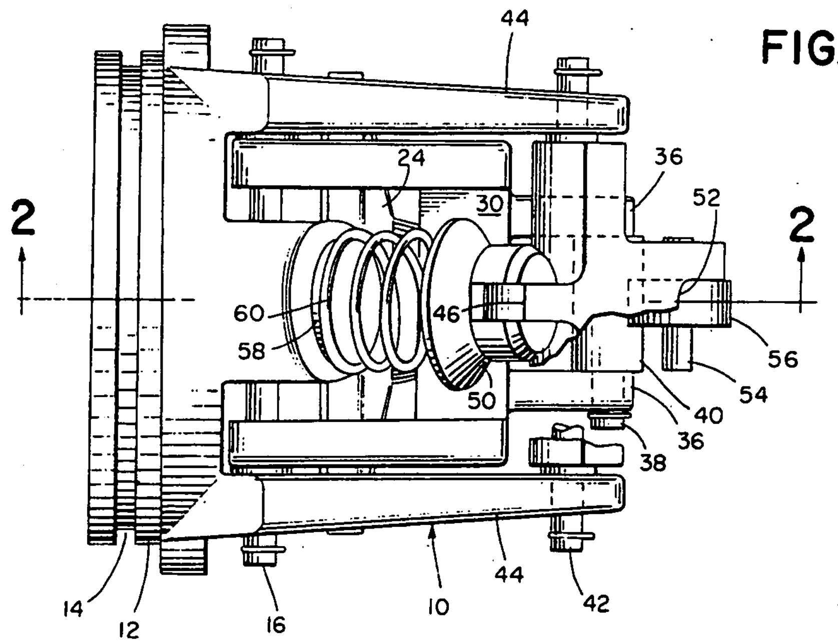

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FIG. 1

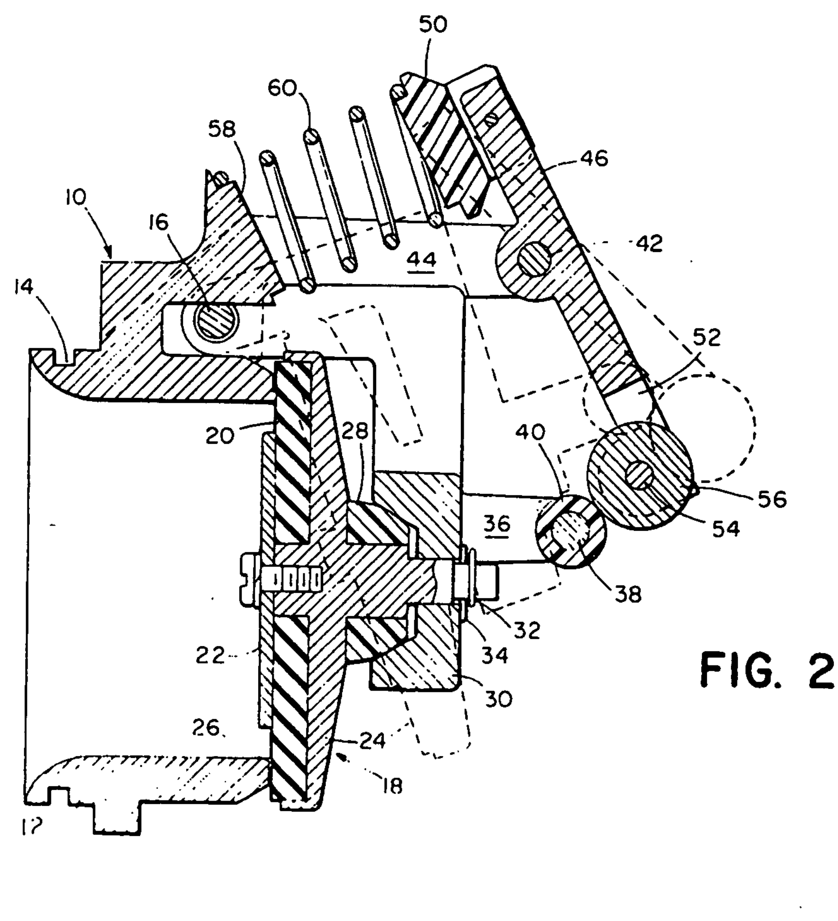
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FIG. 2

CHANGING BIAS CHECK VALVE

SUMMARY OF THE INVENTION

The invention provides a check valve in which the force terfding to bias the clapper in a closed direction may be predeterminedly related to flow conditions in the check valve to obtain a desired curve of flow rate versus pressure drop over the range of operating conditions and which is at the same time extremely practical to manufacture and reliable in use. The invention is characterized by a cam arm pivotally mounted centrally thereof on the clapper support, a compression spring urging one end of the cam arm away from the clapper support, and means transmitting force along a plane extending through a line transverse of the cam arm toward the other end thereof and through a line transverse of the clapper assembly to tend to bias the clapper in a closed direction. In a preferred embodiment, the spring applies its force to the end of the cam arm through a spring engagement bushing mounted on said cam arm pivotally about a transverse axis, and a rotatable roller at the other end of said cam arm engages a rotatable roller on the clapper assembly.

BACKGROUND OF THE INVENTION

This invention relates to check valves.

It is known in the art that it is desirable, in a check valve, to provide for modifying the force tending to bias the clapper in a closed direction as flow condition in the valve varies. Thus, in Curtiss et al. U.S. Pat. No. 3,478,778, "Clapper Valve with Changing Bias," granted to the assignee of the present invention on Nov. 18, 1969, a tension spring was used to bias a cam arm, and a diminishing torque tending to bias the clapper in a closed direction was exerted as the clapper opened further because the moment arm through which the spring's force was exerted on the clapper deceased as the clapper opened.

It is also recognized that a check valve should be capable of being reliably and reproducibly manufactured under production conditions, and should be reliable in use.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a plan view of the presently preferred embodiment of the invention; and

FIG. 2 is a sectional view taken at 2—2 of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

There is shown in FIGS. 1 and 2 a clapper support 10 provided with a flange 12 carrying an O-ring groove 14 for engaging hardware upstream thereof in use.

Pivotally mounted in the clapper support 10 on transverse shaft 16 is a clapper assembly indicated generally at 18.

The clapper assembly 18 includes a rubber annulus 20 secured by a washer 22. The clapper 24 has some universal movement relative to the valve seat 26 owing to provision of the plastic bushing 28 which is slidably angularly moveable relative to the clapper arm 30, the snap ring 32 and washer 34 being accordingly positioned. A pair of arms 36 extending in a downstream direction from the clapper support 30 carry a shaft 38 on which is rotatably mounted a plastic roller 40.

Rotatably mounted on shaft 42 carried in arms 44 of clapper support 10 is cam arm 46. Pivotally mounted at the upper end of cam arm 46, on lateral shaft 48, is plastic spring engagement bushing 50. Rotatably mounted in slot 52 at the other end of cam arm 46, on transverse shaft 54, is stainless steel cam roller 56.

Extending between a spring support portion 58 of the clapper support 10 and the bushing 50 is compression spring 60.

In operation, in closed position the force exerted by compression spring 60 tends to bias cam arm 46 about the transverse axis of shaft 42. Accordingly, the roller 56 exerts force against the roller 38 to hold the clapper rubber 20 against the valve seat 26. Because the rollers 56 and 40 have cylindrical surfaces, the force exerted by the former on the latter is exerted along the plane defined by the transverse axes of the shafts 54 and 38, as is true not only in the closed position of the check valve but in all its positions. As water pressure rises sufficiently to crack and then increasingly open the check valve, the cam arm 46 pivots about the shaft 42 toward the position indicated in the dahsed lines. As movement in that direction takes place, the effective moment arm of the plane connecting the axes of the rollers about the axis of the shaft 16 decreases considerably, so as to have much more effect on the torque being exerted on the clapper assembly than does the fact that the force exerted by spring 60 incrases owing to additional compression. In the preferred embodiment, the diminishing torque is effective to maintain the curve of pressure drop versus flow rate approximately flat throughout the entire operating range of 0 flow to rated maximum capacity flow, although lever arms and spring characteristics and other parameters familiar to the art may be varied so as to change the direction of the curve just referred to as desired.

Other embodiments within the invention will be apparent to those skilled in the art.

What is claimed is:

1. A check valve comprising:

a clapper support,

a clapper assembly rotatably mounted on said clapper support,

a cam arm rotatably mounted intermediately thereof on said clapper support,

a compression spring extending between said clapper support and a first end of said cam arm, and

means securing said cam arm toward the other end thereof to said clapper assembly so that force is applied from said cam arm to said clapper assembly through a plane passing through an axis transverse of said cam arm toward said other end thereof and through an axis transverse of said clapper assembly

wherein a cylindrical cam surface at said other end of said cam arm is urged against a cylindrical surface carried by said clapper assembly owing to the force on said cam arm from said compression spring.

2. The check valve of claim 1 in which said cylindrical cam surface is the surface of a cylindrical element carried by said cam arm.

3. The check valve of claim 2 in which said cylindrical element is rotatably mounted on said cam arm for rotation about said axis transverse of said cam arm.

4. The check valve of claim 1 in which said cylindrical surface is the surface of a cylindrical clapper assembly element carried by said clapper assembly.

5. The check valve of claim 4 in which said cylindrical clapper assembly element is rotatably mounted on said clapper assembly for rotation about said axis transverse of said clapper assembly.

6. The check valve of claim 1 in which said cylindrical cam surface is the surface of a cylindrical element rotatably mounted on said cam arm for rotation about said axis transverse of said cam arm, said cylindrical surface is the surface of a cylindrical clapper assembly element rotatably mounted on said clapper assembly for rotation about said axis transverse of said clapper assembly, and one of said cylindrical elements is plastic and the other thereof is stainless steel.

7. The check valve of claim 6 in which said clapper assembly cylindrical element is plastic.

8. The check valve of claim 6 in which said cam arm carries at said first end a spring engaging bushing engaging said compression spring, said spring engaging bushing being pivotally mounted on said cam arm to pivot about an axis transverse thereof.

* * * * *

United States Patent [19]

McIlroy

[11] **3,908,208**

[45] **Sept. 30, 1975**

[54] **QUICK RELEASE SAFETY TRAP**

[76] Inventor: **John C. McIlroy**, 906 Baldwin, Lapeer, Mich. 48446

[22] Filed: **May 10, 1973**

[21] Appl. No.: **358,996**

[52] **U.S. Cl.** **4/207**; 4/DIG. 7; 137/247.49; 138/118; 285/157

[51] **Int. Cl.²**.. **E03C 1/284**

[58] **Field of Search** .... 4/206, 207, 1, 8, 10, 2–5, 4/95, 166, 187, 188, 191, 197, DIG. 7, 255, 4/257, 252 R; 285/157, 252, 253, 423, 93, 285/DIG. 12, DIG. 14, 4; 138/106, 107, 118, 138/121, DIG. 2, 7, 8, 11; 137/247.41, 247.49

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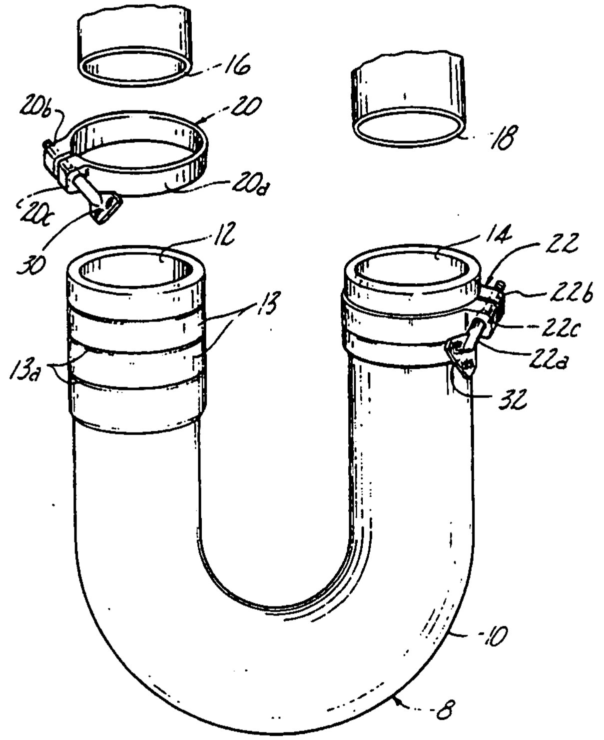
"Jessall Plastics" from Modern Plastic Encyclopedia, 1959, Vol. 36, No. 1, p. 460.

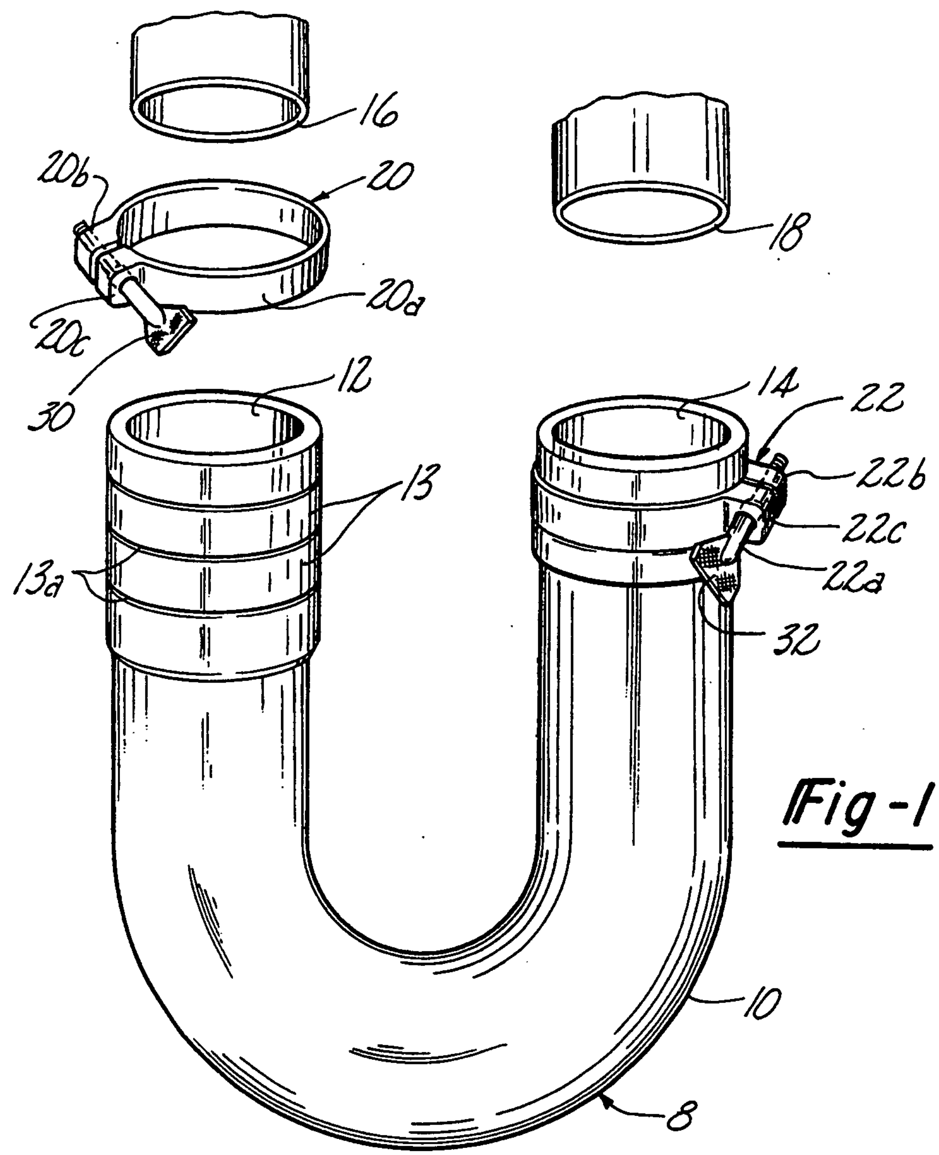
Primary Examiner—John W. Huckert
Assistant Examiner—Stuart S. Levy
Attorney, Agent, or Firm—Hauke, Patalidis & Dumont

[57] **ABSTRACT**

The plumbing line trap provided is fabricated from a deflectable type of plastic material and is easily cleaned once removed and placed in the cleaning position. Removal is facilitated by the construction of the two free ends of the return bend of the trap each of which includes a collar for retaining in place a resilient clamp which is loosened or tightened through the operation of an associated threaded fastener. The material from which the return bend is fabricated is preferably a high density polyethylene of a clear or transparent type which admits light and thus permits the home owner to readily determined whether or not cleaning is necessary or impending.

1 Claim, 2 Drawing Figures




16
20b
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18
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20c
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22
22b
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22c
13a
22a
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Fig-1

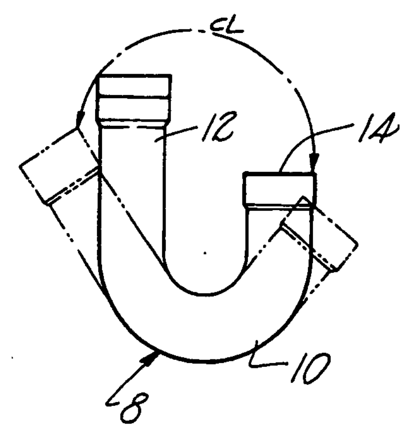
CL
12
14
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Fig-2

QUICK RELEASE SAFETY TRAP

BACKGROUND OF THE INVENTION

The present invention relates to an improvement in traps and is particularly adapted for use in kitchen sink traps, bathroom sink traps, and bathtub traps, all of which receive waste water and along with the waste water a solid sediment or partially insoluble substances which tend to clog the piping system so as to require periodic cleaning. When the traps become clogged, since the trap sections are generally connected by semi-permanent or sealed fasteners, they may well require the work of a professional plumber with the attendant high cost and time delay involved.

The great majority of return traps used are fabricated from a metallic pipe, being most commonly of cast iron, steel, copper or lead. In order to make a leak-proof connection, even in return lines where the fluid pressure drop is relatively low, it is necessary to achieve a tight connection, either through bell and spigot type joints, flanged joints, or in some cases through threaded and doped joints. Once the trap has been removed it is necessary to have a professional type reinstallation to prevent leaking of the connections.

An alternative used by some home owners is to periodically douse the kitchen sink drain with caustic type cleaners which are intended to dissolve accumulated waste in the trap so that it will be carried away by later flow of liquids. The grease clogging associated with the kitchen sink requires frequent use of the highly toxic caustic substances. It is well known that such substances when kept in the house and within the reach of children are exceedingly harmful and dangerous to life if misused. In addition, such substances tend to corrode and erode the metallic pipe parts. The present invention eliminates the need for such cleaners.

BRIEF DESCRIPTION OF THE PRESENT INVENTION

The present invention, as will become apparent from the following description and explanation, is related to a quick release trap which is particularly useful in a home plumbing system in which the trap itself may be bought as a replacement item to replace the standard troublesome trap in the plumbing system. Alternately and in accordance with recent code revisions in a number of locales, this type of trap may be incorporated as a part of the original plumbing installation.

Further advantages are afforded by the present invention since it may be unclamped, disconnected, cleaned and reclamped in place without the use of wrenches or other tools. Indeed, the entire operation may be performed by a housewife without assistance of technically skilled people. It is possible to view the condition of the trap without disassembling it by reason of the clear plastic pipe incorporated as the return bend in the trap construction. An additional advantage afforded by the improved trap is that the material used to fabricate the return bend pipe in the trap is readily deflectable over a distance sufficient to permit passage of a length of common hose through it to accomplish a cleaning operation. No specialized "snake" or flexible tubing is needed to pass through and clear the obstruction in the bend.

In an alternate embodiment of the invention, the return bend portion of the trap has one vertically upstanding leg somewhat shorter than the other to admit its connection in a waste return system where this pipe connection requirement exists. Here again, this ready deflection of the return bend of the trap expedites the cleaning of the trap and the passage of the cleaning hose or instrument through the bend.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will now be described with reference to the attached description in which like numerals are used to refer to like parts where they may appear throughout the several views, and wherein:

FIG. 1 is a perspective view of the trap according to the present invention with one of the two end clamping devices removed; and

FIG. 2 is a partial view of an alternate embodiment of the pipe bend portion of the trap showing the end pieces in their deflected or spread cleaning position.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

As is shown in FIG. 1 of the drawings, the trap **8** includes a return bend portion **10** which typically extends downwardly when the trap is installed in the plumbing line system. The two free ends **12** and **14** of the trap are sized to receive a standard OD pipe such as is used in sink waste water return lines. To properly illustrate the invention, a pair of pipes **16** and **18** are shown in their normal position above the free ends **12** and **14** of the trap **8**. A pair of metallic clamps **20** and **22** are incorporated as part of the quick release trap to provide for a rapid release of the trap when clean-out is required. Included in the clamping devices **20** and **22** are a pair of substantially circular clamps **20*a*** and **22*a***, respectively. The bent-over ends, **20*b*** and **20*c***, 22*b* and **22*c***, are threaded or adapted to receive the threaded stem of an extended end T-shaped end tightening screw, **30, 32,** respectively. The structure of the clamping devices **20** and **22** will thus be seen to allow for ready loosening and tightening of the trap **8** in place even by an unskilled person.

A particular advantage in the present invention has been noted with respect to fabrication of the central pipe return bend **10** from a substantially transparent plastic material, such as, for example, from a high density polyethylene substance. Such substances are now readily available in commercial form and are resistant to temperatures through the range of **200°–240°F.**, which temperatures are, of course, highly in excess of those which would be encountered in exhaust fluids as they exit from household or even from most commercial sink systems.

An alternate substance from which the pipe return bend **10** of the trap **8** might be constructed or cast are polypropylene copolymers which, while they may not be available in clear or substantially transparent versions, are such they they will admit light to a sufficient degree to determine whether or not the bend **10** is becomming filled with sediment, grease or dirt so that it is in a condition requiring removal and cleaning. These latter described substances are resistant again to the temperatures of the water passing through them through a range of **190°** to approximately **240°F**, likewise safely allowing for the passage of any typical exhaust liquids used in most sink installations.

FIG. 1 also shows one of the two leg or end portions **12** predivided into a plurality of segmental break-off

portions **13** along precast or scribed frangible lines **13***a*. This permits breaking the leg portion **12** to a predetermined length to match the length of an opposed drain pipe **16**.

The FIG. **2** drawing illustrates an alternate embodiment of the present invention in which the upwardly extending end **12** of the pipe bend **10** is shorter than the other end **14** to provide for installation in a plumbing pipe line where this condition exists with respect to the mating stationary pipes **16** and **18**. The FIG. **2** drawing further shows in phantom outline the manner and proportional degree to which the legs may be deflected, one relative to the other, once the trap **8** has been removed and is placed in a cleaning position when the cleaning is accomplished by the passage of water from a hose and/or by the hose itself. The possible extent of radial movement of the parts is illustrated and shown by the letters CL., which designation relates to the cleaning deflection condition of the trap **8**. Once the cleaning operation has been completed, the above described two types of material are such that the pipe bend **10** returns at once to its initial solid line designated condition and the unit is ready for quick reinstallation in the plumbing pipe waste water return system.

It will thus become apparent that I have provided an improved waste return trap which is both novel and substantially advanced over the prior art with respect to its removal, its cleaning, its resistance to corrosion and galvanic wear, and the manner in which it may be simply checked before disassembly through visual inspection.

The present invention thus achieves a meritorious advance which not only elminates the use of dangerous

drain cleaning caustics in the home but, at the same time, operates to reduce resultant pollution to our rivers, lakes and streams.

What is claimed is:

1. A quick release trap for use in connection with waste water return plumbing lines, comprising:

an arcuately curved pipe bend portion having a pair of upwardly disposed leg portions sized to receive a corresponding one of a pair of mating downwardly oriented pipes;

each of said leg portions having a plurality of segmented and frangible end portions;

a pair of clamps engageable over individual ones of said segmented end portions for attaching each respective leg portions to the opposed pipe;

a threaded fastener engageable with opposed extending lips from each of said clamps for tightening each clamp about the associated segmented end portion for holding the bend portion tightly attached at both leg portions to the mating pipes;

said bend portion and said leg portions all being constructed of a high density polyethylene substance for admitting light through their walls to make possible a visual inspection of the condition of the pipe bend preparatory to removal for cleaning, and

each of said leg portions being readily and separately detachable from its opposed pipe and deflectible over a substantial distance whereby a water hose or other like cleaning instrument may be inserted for removing and dislodging clogging material from the bend portion.

* * * * *

United States Patent [19]

Schützer et al.

[11] 3,990,471

[45] Nov. 9, 1976

[54] **FLAP VALVE**

[75] Inventors: Gerhard Schützer, Stuhr; Friedrich Schittek, Bremen, both of Germany

[73] Assignee: Gustav F. Gerdts KG, Bremen, Germany

[22] Filed: Apr. 15, 1975

[21] Appl. No.: 568,344

[30] **Foreign Application Priority Data**

May 28, 1974 Germany 2425879

[52] U.S. Cl. 137/527; 251/337

[51] Int. Cl.^{2} F16K 15/03

[58] Field of Search 137/527, 527.2, 527.4, 137/527.6, 521; 251/337, 303, 313

[56] **References Cited**

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FOREIGN PATENTS OR APPLICATIONS

811,237	4/1959	United Kingdom

Primary Examiner—William R. Cline

Attorney, Agent, or Firm—Allison C. Collard

[57] **ABSTRACT**

A flap valve, in particular a check valve comprising a valve housing and a valve seat formed therein, a plate-like locking member cooperating with the valve seat, the locking member being pivotably mounted to the housing, a locking spring extending across a remote front face and having a longitudinal axis substantially crosswise with respect to the pivot direction of the locking member. The locking spring is held axially pretensioned with one end on the valve housing and with another end on the locking member and the locking spring has the form of a leg spring and at least one winding connecting the legs. The windings are mounted substantially parallel to the front face of the locking member.

7 Claims, 3 Drawing Figures

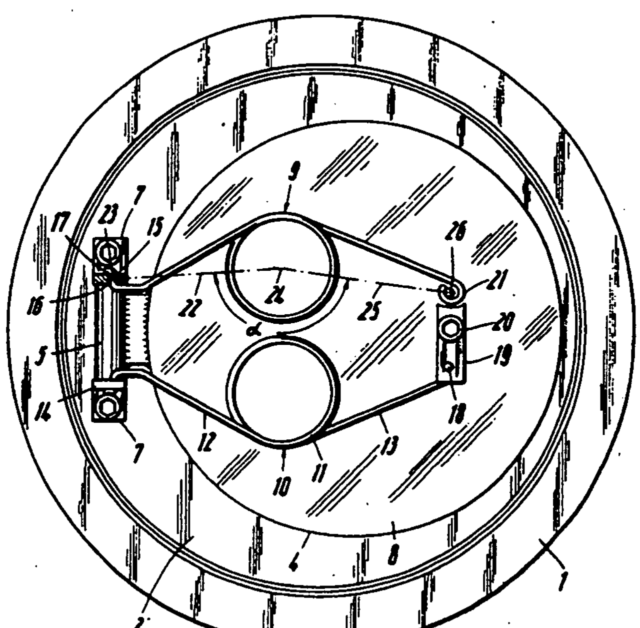

Fig. 1

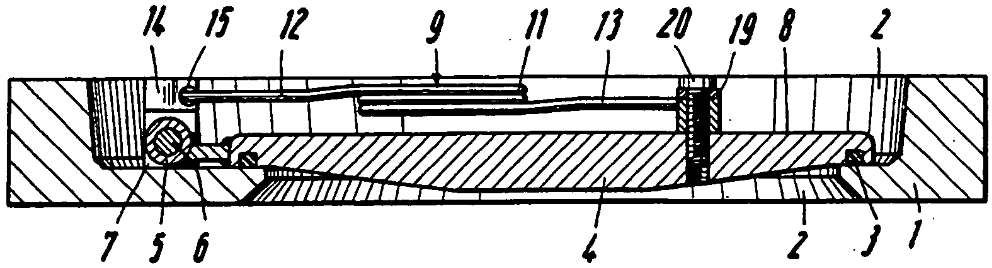

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Fig. 2

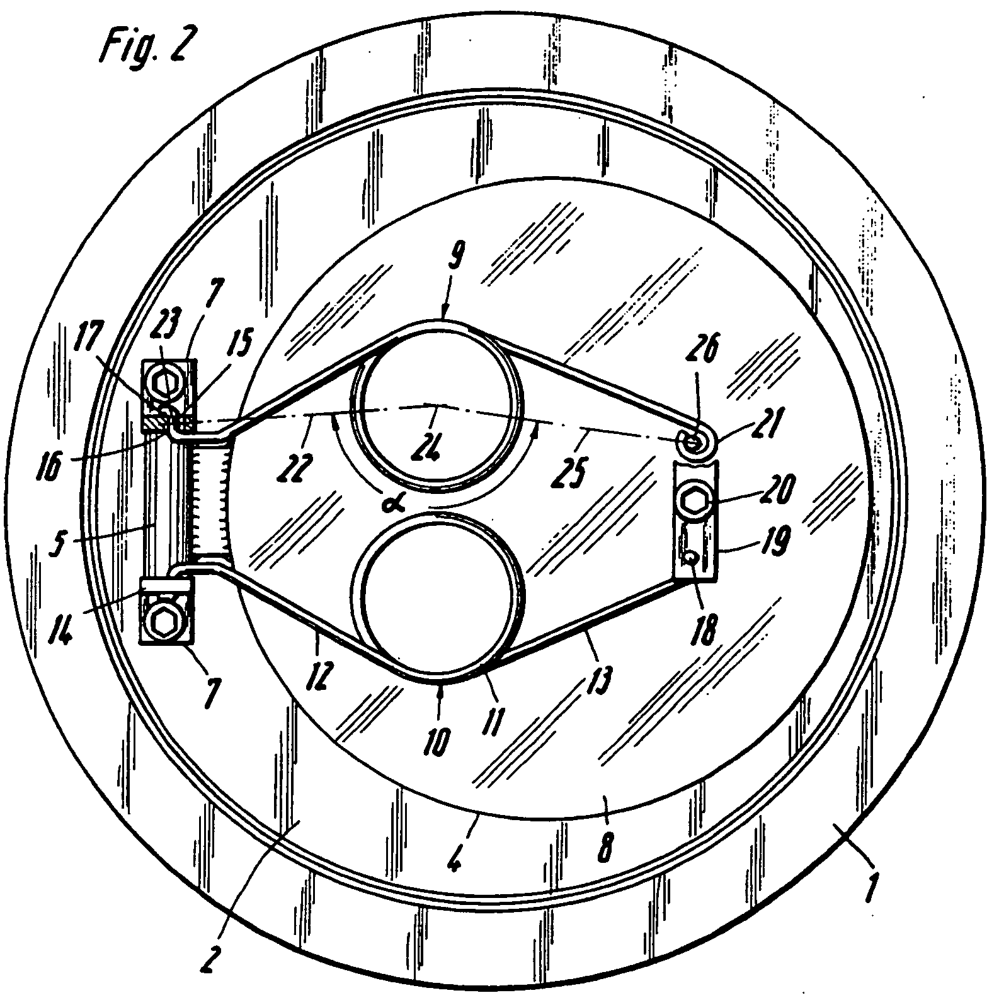

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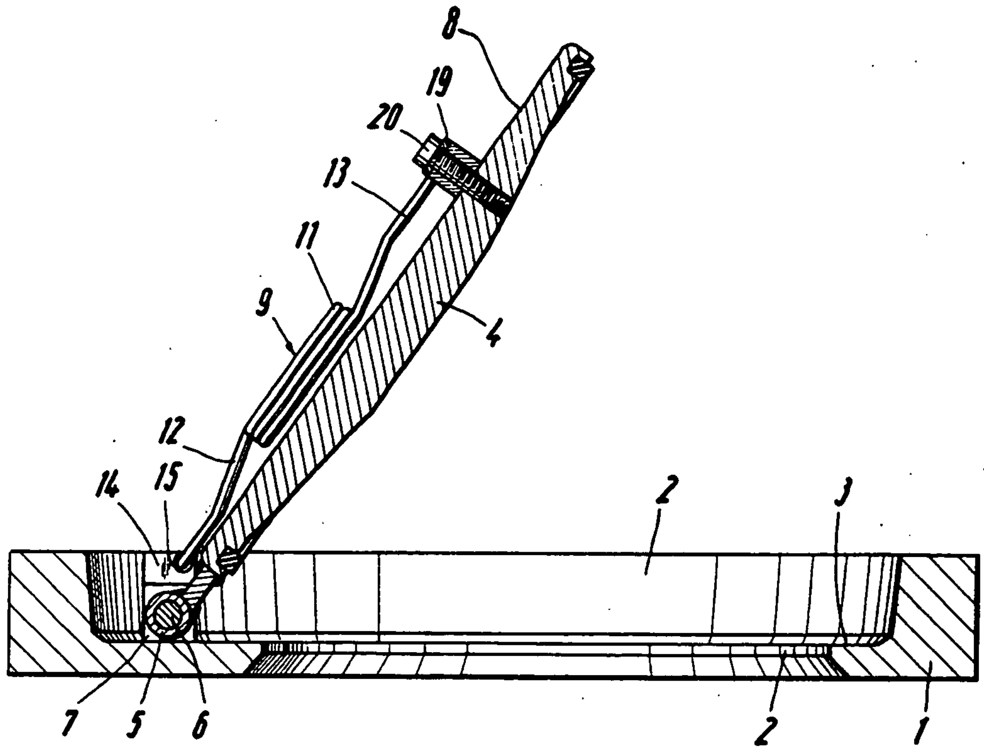
Fig. 3



FLAP VALVE

The present invention relates to a check valve in general and, in particular, to valves of the flap type.

It is important to make sure that the locking effect of the valve spring increases only slightly above the opening hub of the locking member, or to even decrease this effect. The purpose is to eliminate unstable and partly open positions in the check valves and to assure a complete opening of the valve.

This particular type of locking effect is provided by a check valve having a valve housing and a valve seat, a plate-like member which cooperates with the valve seat, the locking member being pivotably mounted on an axle which is mounted in the valve housing, and with a locking spring which extends across the front face of the locking member, which face is remote from the valve seat, whereby the longitudinal axis is substantially lateral with respect to the pivot direction of the locking member, and the locking spring being attached with one end to the valve housing and with the other end on the locking member in axial direction. The valve spring moves vertically with respect to the pivot movement of the locking member. For this purpose, the spring is supported behind the center of rotation at the valve housing, when viewed from the valve seat, and creates a rotating movement on the locking member in the locking direction. If, when seen from the valve seat, the supporting point for the spring is laterally offset with respect to the center of rotation of the axis, the required length of the lever arm for creating the required locking moment is decreased. Thus, an increase of locking movement with respect to the effect on the locking member can be compensated, and if need be, even decreased in its closing effectiveness.

In a known embodiment of these types of valves (British Pat. No. 811,237), a leaf spring is used as the spring element which is arched vertically with respect to the locking member front face. It had been shown that the desired eveness or decreasing of the spring force at the locking member could not be maintained due to the relative stiffness when the leaf spring is loaded in sense of buckling. With respect to the construction of the flap valve it is extremely difficult to arrange the center of rotation of the locking member and the spring mounting in such a way that the increase in spring pressure, which is exerted on the locking member can be adequately compensated during the opening movement of the valve. Another disadvantage exists due to the arching of the leaf spring above the front face of the locking member. This requires the providing of a large receiving chamber which can be penetrated by the leaf spring when the locking member is pivoted outwardly, so as not to be subjected to a premature hub limitation by the housing wall. Furthermore, the arch in the leaf spring is increased during the opening movement of the valve.

It is therefore an object of the invention to improve the valves of the aforementioned types in that only a slight increase of the spring effect on the locking member occurs, while the valve is moving into an opening position. Furthermore, the locking spring can be constructed in the form of a relatively flat member.

The leg spring which is used in the present invention has a lesser stiffness with respect to the leaf spring, so that an eventual increase in the spring force during opening of the valve is very low. This facilitates the

desired spring effect on the locking member. Furthermore, the suggested spring requires only a low structure above the front face of the locking member, because the spring is in a very flat position and because the movement of the spring during opening of the valve takes place in a substantially parallel plane with respect to the front face. However, the spring movement does not affect the height of the construction of the device.

In accordance with a further improvement the force of the spring does not increase, but actually decreases in the final stage during the opening movement of the valve which facilitates the spring effect on the locking member when opening the valve.

It is possible to further decrease the height of spring constructions, because due to the use of two adjacent leg springs the individual spring may be dimensioned substantially weaker and flatter.

The invention also provides advantageous embodiments for the spring abutments. The leg springs are mounted with only a few simple mounting means, so as to prevent an outward pivoting from their mounted position which is parallel with respect to the locking member.

Other objects and features of the present invention will become apparent from the following detailed description when taken in connection with the accompanying drawings which disclose several embodiments of the invention. It is to be understood that the drawings are designed for the purposes of illustration only, and are not intended as a definition of the limits and scope of the invention.

In the drawings wherein similar reference numerals denote similar elements throughout the several views:

FIG. 1 is a sectional view of the check valve of the invention in closed position;

FIG. 2 is a plan view of the check valve of FIG. 1; and

FIG. 3 is a sectional view of the check valve of FIG. 1 in the open position.

Referring now to FIGS. 1-3, a disk-like valve housing 1 is provided with an increasingly widening canal 2 which is offset at its outlet side. The front face of the canal heel portion forms the valve seat 3 at the inner edge portion and receives a plate-like locking member 4. This member is pivotably mounted on an axle 6 by means of a bushing 5, whereby the axle is mounted in two support shoulders 7 which are mounted on the valve housing 1.

For the locking loading of the locking member 4, two leg springs 9, 10 are provided across a front face 8 which faces away from the valve seat 3. These springs are mounted homologous (mirror inverted) adjacent to each other and are provided with a plurality of parallel mounted windings 11. The ends of the windings form legs 12, 13 which run substantially parallel with respect to the front face 8, but run opposite with respect to each other.

The mounting supports 7 are provided with arresting arms 14 and serve as abutments for the leg springs 9, 10. These arms 14 are provided with bores 15 which run parallel with respect to the pivot axle 6. Furthermore, these bores, when seen from the direction of valve seat 3 are mounted at a distance behind the center axis of rotation and are laterally offset with respect to the center axis of rotation and with respect to the locking member 4.

For retaining leg springs 12 at the abutment, the leg springs 12 are provided with angular portions 16 which pass through the bores 15 in the axial direction. The

end sections of the angular portions which freely extend from the bores are radially bent in the form of safety catches 17, which prevent the spring ends from sliding out of the bores 15 during the operation of the valve. The bores 15 and the safety catches 17 are such that the angular portions 16 including the safety catches 17 can be easily introducted through the bores during assembly. There is also the necessary pivot possibility of the leg spring 12 parallel to the front face 8.

Pins 18 serve as abutments for the springs at the locking member, which pins extend vertically from the front face 8 of the locking member and carry a transverse member 19 at their free ends. This transverse member 19 is fixedly connected between the two pins 18 with locking member 4 by means of a screw 20. The legs 13 of the leg springs 9, 10 are each provided with a mounting loop 21 at the free ends of the legs each of which loop 21 encompasses each pin 18. In this manner, the leg springs 9, 10 are non-detachably connected with locking member 4. This arrangement also assures the required pivot movement of lever arms 13 parallel to the front face 8.

Furthermore, the leg springs 9, 10 are safely mounted at the housing portion and the locking member against an outwardly pivoting of the position parallel with respect to the front face 8.

Furthermore, the leg springs 9, 10 are tensioned with pretension between their abutments 14, 18. The structure of the leg springs is such that in the relaxed spring condition, i.e., before installing the spring into the valve, the ideal straight line 22 between the supporting point 23 of the leg 12 and the winding axis 24 with respect to the ideal straight line 25 between the supporting point 26 of the leg 13 and the winding axis 24 stands at an angle α of more than 180°. For installation, the leg springs 9, 10 are pretensioned to such an extent until the ideal straight lines 22, 25 are swung across the outstretched position into an angle α of less than 180°, as can be seen from FIG. 2.

The forces of the leg springs 9, 19 increase in the longitudinal direction, i.e., in the direction of the connecting straight lines 22, 25 when compressed while pivoting locking member 4 outwardly, provided that the corresponding straight lines 22, 25 are at an angle α of less than 180° with respect to each other. This is achieved by the aforementioned pretension of springs 9, 10 so that the spring force decreases substantially during the longitudinal compression of the springs.

When outwardly pivoting the locking member 4, the effective lengths of the lever arm between the axle 6 and the supporting point 23 shorten which effect the leg springs 9 and 10 and on the locking member 4. This shortening of the effective lever arm length and the decreasing spring force result in a decrease of the spring forces on the locking member 4, which facilitates the locking effect as desired in check valves.

While only a single embodiment of the present invention has been shown and described, it will be obvious to those skilled in the art that many changes and modifications may be made thereunto without departing from the spirit and scope of the invention.

What is claimed is:

1. A flap valve, in particular a check valve comprising:

a valve housing having a valve seat formed therein;

a plate-like locking member cooperating with said valve seat;

an axle disposed on said valve housing, for pivotably mounting said locking member; and

at least one locking spring extending across a front face of said locking member, said front face being remote from said valve seat and having a longitudinal axis substantially crosswise with respect to a pivot direction of said locking member, said locking spring being held axially pretensioned with one end of said valve housing and with another end on said locking member, said locking spring having the form of a leg spring having two ends constituting legs and at least one helical winding connecting said legs, at least one said helical winding defining an axis, said legs extend opposite to each other and transverse relative to the axis of said helical winding, and wherein said at least one winding is mounted substantially parallel to said front face of said locking member.

2. The flap valve according to claim 1 wherein said leg spring defines (an) a first ideal straight imaginary connection line between (an) the axis of said winding of the spring and a point of connection of the spring to said locking member, as well as (an) a second ideal straight imaginary connection line between said axis of said winding and a point of connection to said valve housing;

said first and second ideal imaginary connection lines being oriented (disposed) at an angle of (over) more than 180° in a completely (relaxed) unconnected untensioned state of said spring; and in (an) a connected installation position in said flap valve, constituting a stretched pretension position of said spring legs in said flap valve, said first and second straight imaginary connection lines being (pivoted) oriented at an angle of less than 180°.

3. The flap valve according to claim 1 wherein said at least one locking spring constitutes two leg springs arranged in mirror inverted position.

4. The flap valve according to claim 1 further comprising a housing abutment for said locking spring constituting two arresting arms which are connected to said valve housing, said housing arms being formed with bores which run parallel to the pivot axle of said locking member, and said spring being formed adjacent said housing with an angular portion at a free end thereof which engages one of said bores in an axial direction thereof, and said angle portions including safety catches which extend radially from said bores, respectively.

5. The flap valve in accordance with claim 1 further comprising:

a spring abutment provided at said locking member and constituting two retainer pins which extend vertically with respect to said locking member; and

(of) said at least one locking spring constitutes two locking springs, each of said two locking springs is formed with a loop formed at a free end thereof, said loop pivotably surrounding a corresponding one of said retainer pins.

6. The flap valve according to claim 5 further comprising a head piece disposed on an end of each of said pins complementary to the size of said loop to prevent said loop from sliding off said pin.

7. The flap valve according to claim 1 wherein said at least one helical winding comprises a plurality of superimposed helical windings.

* * * * *

United States Patent [19]

McIlroy

[11] **3,995,888**

[45] **Dec. 7, 1976**

[54] **FLEXIBLE PIPE CONNECTOR**

[76] Inventor: **John C. McIlroy**, 906 Baldwin, Lapeer, Mich. 48446

[22] Filed: **Apr. 21, 1975**

[21] Appl. No.: **570,159**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 358,996, May 10, 1973, Pat. No. 3,908,208.

[52] **U.S. Cl.** **285/4**; 285/93; 285/177; 285/179; 285/253

[51] **Int. Cl.²** **F16L 25/00**; F16L 43/00

[58] **Field of Search** .... 285/4, 3, 93, 177, 236, 285/179, 157, 253, 334.4; 4/207, DIG. 7, DIG. 13, DIG. 16

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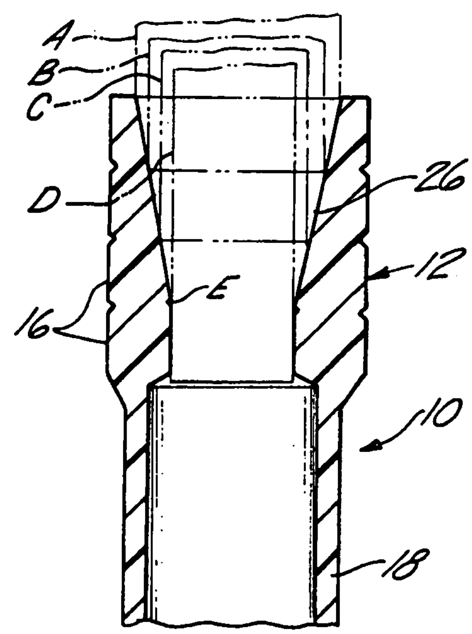
Primary Examiner—Thomas F. Callaghan
Attorney, Agent, or Firm—Harry R. Dumont

[57] **ABSTRACT**

The pipe connector is fabricated from a deflectible type of plastic material and may be easily removed and cleaned when this is necessary. Both the initial construction of the plumbing system and the subsequent removal and repair are facilitated by the specialized construction of the two free ends of the bend portion, each of which has associated with it a resilient clamp which is loosened or tightened through the operation of an associated threaded fastener. The material from which the connector is fabricated is preferably a high density polyprophylene of the clear or transparent type which admits light and permits the homeowner or plumber to inspect the plumbing system and to readily determine whether removal and cleaning is necessary.

4 Claims, 3 Drawing Figures



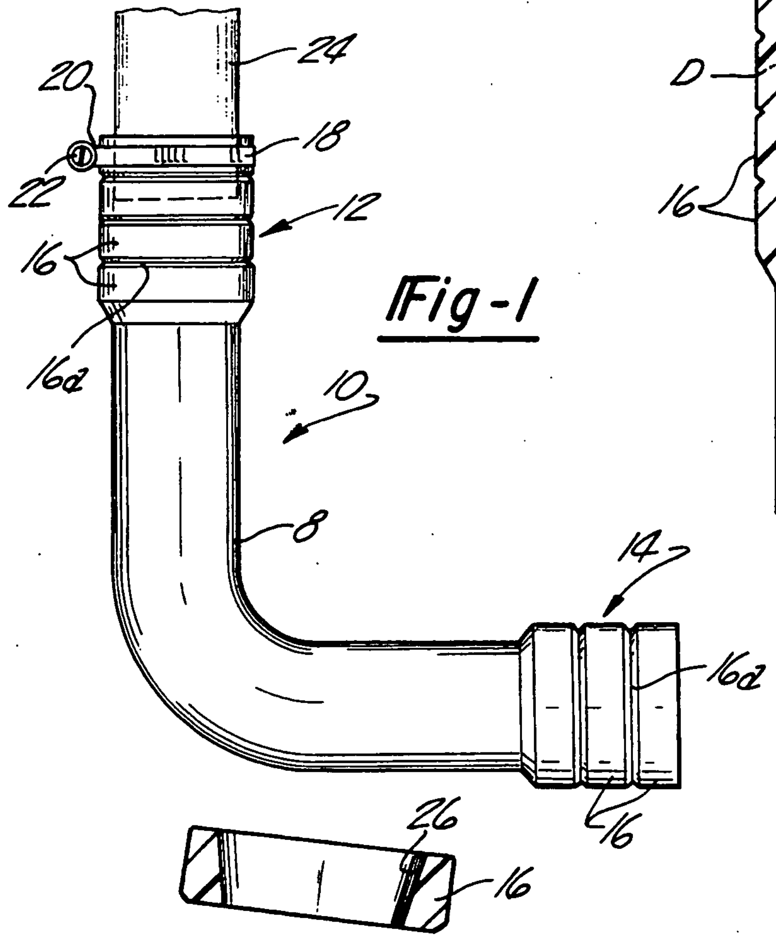


Fig-1

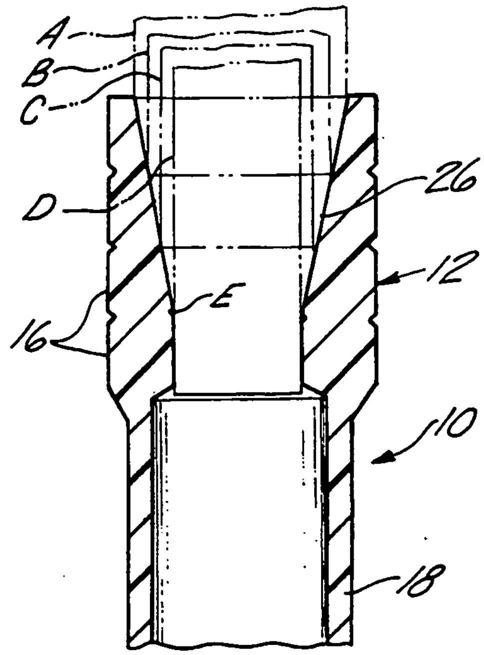


Fig-2

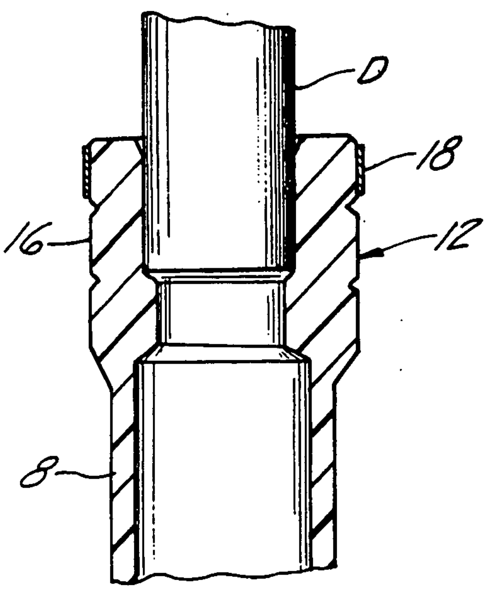


Fig-3

FLEXIBLE PIPE CONNECTOR

REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part of my U.S. patent application Ser. No. 358,996 filed May 10, 1973 for "Quick Release Safety Trap" issued on Sept. 30, 1975 as U.S. Pat. No. 3,908,208.

BACKGROUND OF THE INVENTION

The present invention relates to an improvement in pipe connectors and is adapted for use with plumbing systems including pipe made of copper, brass, lead, steel or plastic. In the initial construction of the plumbing system, pipe ends for either carrying in water or carrying out waste are typically threaded and the pipe couplings used are likewise threaded so that the juncture is made. In addition, pipes being joined intersect at different angles so that a number of different angular bends are required for the connectors, either in their off-the-shelf condition or as they are fabricated and bent on the site by skilled plumbers. Over a prolonged period of use where the pipes have been joined by metallic connectors, there occur both corrosion and strains. The strains are caused by cutting, threading and joining pipes and by subsequent expansion and contraction of the water lines. Since all waters and soils tend to corrode the pipe, the corrosion action occurs and is particularly noticeable at threaded joints in the pipe. The results are red water, reduced flow capacity and shortened life of the entire plumbing system Indeed, the bore of the pipes, particularly where the metallic couplings are connected, may become clogged or finally closed with a rusty coating or deposit long before the wall of the pipe itself has been subjected to any destruction.

It is well known that pipes of iron have relatively rough interiors which serve to retard the flow of water, while brass and copper pipes on the other hand have smooth interiors which allows for a greater flow of water over a long period. Even in the preferred types of pipes, it is necessary that they be cut with some precision and then threaded prior to installation of the couplings between pipes. A further weakness inherent in any threaded pipe is that the end portions which have been threaded are subject to strain lines which later may develop into fracture lines and leakage to the pipe.

With pipe connectors according to the present invention, it is possible to provide a relatively small number of different angular connectors which, because of their deflectible nature, will cover a broad range of angular requirements. The connection of the pipes can be made without requiring the high degree of skilled labor now required for plumbing installation in that the connector itself is of an adjustable length by reason of the segmented sections and once the pipes to be joined are in place the joining may be completed simply through a C-clamp attachment used in conjunction with the present invention.

Thus, it will be seen that the present invention allows for a strong and permanently water-tight joint without requiring placing unusual strain on the piping at any point. The physical strength of the pipe and the connector is greatly increased since there is required no threading in which the metal is cut away, leaving a pipe much thinner at the thread roots and subject to breakage and to later leaking.

A second outstanding advantage of the present invention is that once the system has been assembled and put in use it is possible to periodically check the joints and determine whether or not any clogging is beginning. Once the connector has been removed in a typical metal connector installation, it is necessary to rejoin the elements and to make a second leakproof connection with caulking, solder or the like. Even in return lines where the fluid pressure drop is relatively low, it is necessary to achieve a tight connection either through relatively complicated bell and spigot-type joints, flanged joints, or in other cases through threaded and doped joints. Otherwise stated, once the obstruction has been removed, it is often necessary to have a professional-type reinstallation to prevent a later leaking of the connections. The present invention eliminates this requirement.

BRIEF DESCRIPTION OF THE PRESENT INVENTION

The present invention, as will become apparent from the following description and explanation, is related to an easily installed connector which is particularly useful in a broad variety of plumbing systems, both from the viewpoint of reducing the cost of initial installation of the plumbing system and of later making disconnect, repairs and removal of obstructions simple for the homeowner. Reconnection of the plumbing system is possible without costly professional assistance.

In the initial installation, the connector is of a construction that makes it possible to accommodate a broad range of pipe sizes, all with the same basic connector. This is made possible by the mode of construction of the end portions of the connector. In addition to a segmented and frangible end with a number of break-off sections provided, the opposed end portion internal diameter has an inwardly tapered wall thickness such that a different diameter pipe can be introduced to achieve a snug fit at whatever length its diameter is accommodated. This will be better shown and clarified in the drawings hereinafter. Since the material of the connector is both flexible and transparent, the first introduction of the pipe end into the end portion will give rise to a visible ring or depression which indicates the desired location in which break-off may be made of the one or more segmented excess end sections to provide a close and neat fit of the connector and mating pipe. Thus, sizing and connection are achieved simply without specialized skill or tools. The final attachement by the clamp is simply and quickly accomplished and in such manner as to allow for quick disconnect when and if that becomes later necessary.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will now be described with reference to the following description and the drawings in which like numerals are used to refer to like parts where they may appear throughout the several views, and wherein:

FIG. 1 is a front elevational view of the connector according to the present invention showing the pipe end portions;

FIG. 2 is an enlarged cross-sectional view with parts broken away to show the internal construction of a pipe being sized and fitted to the connector; and

FIG. 3 is a cross-sectional view substantially similar to FIG. 2 and illustrating the final step in which an excess segmented section has been broken off and removed after prefitting of the pipe.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

As shown in FIG. 1, the connector 10 includes a central arcuate bend portion 8 which may be straight or bent at a 90° angle as shown, or in a range of arcuate bends ranging from 45° to 90° to 120°, for example. The connector 10 may thus be precast in a relatively small number of arcuate shapes. Assembly on the building site can be made without further modification of the several basic connector bend configurations. The connector 10 may be formed of a high density polyethylene material.

An alternative substance from which the connector 10 might be constructed or cast is polyprophylene copolymer which while it may not be available in clear, substantially transparent version, may be such that it will admit light to a sufficient degree to enable one to determine whether or not the bend portion 8 is becoming filled with sediment, grease, dirt or scale so that it is in condition requiring removal and cleaning or replacement. As is well known in the art, both of the above described substances are resistant to the temperature of the water passing through them over a range of approximately 190°–240°, thus safely allowing for the passage of any typical waste liquid passing through plumbing installations.

The connector 10 includes a pair of end portions 12 and 14. Each end portion includes a plurality of segmented sections 16 fabricated along precast or scribed frangible lines 16*a*. This permits breaking off the end portions 12 or 14 to a desired length to match and make a suitable connection to the two pipes being coupled together. While the FIG. 1 embodiment is shown as being a right angle elbow connector, the invention is not limited to any particular angular shape.

Also shown in FIG. 1 is a C-clamp type attachment means identified by the numeral 18. The clamp 18 includes at its left side a pair of upstanding portions 20 which are joined and fastened together through a threaded fastener such as a screw 22. This type of attachment allows for ready connect and disconnect of the connector 10 relative to either of the pipes such as pipe 24 shown at the upper left hand end of the drawing.

The FIG. 2 drawing clarifies the internal construction of the upper one of the two end portions 12. It will be seen that the end portion 12 includes a plurality of similarly sized segmental sections 16. The internal diameter of the end portion 12 includes an inwardly converging tapered internal diameter 26. This tapered internal diameter is substantially coextensive in length with the combined length of the segmented sections 16. The tapered internal diameter 26 is capable of handling a broad range of pipe sizes which are illustrated by four different sized pipes A–D. Since the connector 10 is formed of a readily deflectible plastictype material, when the pipe such as pipe D is introduced into the end of the end portion 12 it will finally seat at some point along the length of the tapered internal diameter and at that portion will leave a noticeable ridge or ring E which will indicate the length to which it has penetrated the end portion 12. To achieve a close and tight connection, it is desirable that the clamp, such as C-clamp 18, is attached about one of the particular segmented sections 16 which is formed above the end of the pipe being inserted in accordance with its size. Thus for pipe D, for example, the best fit would be made by attaching the clamp 18 about the second lower section 16.

As shown in FIG. 3, break-off of the upper section or sections 16 is made after inserting in place the C-clamp 18 and tightening it. Thus the connection finally achieved is one in which there is a slight sealing distortion of the remaining and surrounding sections 16 into confined engagement with the periphery of the pipe.

It will thus become apparent that I have provided an improved flexible-type connector which is both novel and considerbly advanced over the prior art with respect to its initial installation in a plumbing system and with respect to its resistance to corrosion and galvanic wear.

The present invention represents a still further advancement with respect to the manner in which it may be visually examined to determine whether a plugged condition exists. Removal and reassembly can be done without requiring complicated reconnection of the pipe joints.

The present invention thus achieves a meritorious advance with lower cost of initial plumbing installation. It also simplifies and lowers the cost of maintenance over a long period of use.

What is claimed is:

1. A flexible pipe connector for use in coupling a pair of transaxial pipes, comprising:
   - an arcuately curved pipe bend portion having a pair of end portions, each sized to receive a different one of the pair of pipes;
   - each of said end portions having a plurality of segmented and frangible end section each of like outside diameter;
   - a pair of clamps, each engageable over different ones of said segmented end sections for attaching each respective end portion about its opposed pipe; and
   - a threaded fastener engageable with opposed extending lips from each of said clamps for tightening each clamp about the associated segmented end portion and for thus holding the bend portion tightly attached to the pipes;
   - said end portions further having a tapered internal diameter extending inwardly over a length of said end portion substantially equal to the combined length of the segmented end sections.

2. The combination as set forth in claim 1 wherein said bend portion and said end portions are all constructed of a high density polyethylene substance for admitting light through their walls to allow a visible inspection of the condition of the pipe bend preparatory to removal for cleaning.

3. The combination as set forth in claim 1 wherein each of said end portions is readily and separately detachable from its opposed pipe and deflectible over a substantial distance, whereby a water hose or like flexible cleaning instrument may be inserted for removing and dislodging clogging material from the bend portion.

4. A flexible pipe connector for use in coupling a pair of pipes, comprising:
   - an arcuately curved pipe bend portion of a high density polyethylene substance for admitting light therethrough and having a pair of end portions, each sized to receive a corresponding one of the pair of pipes, each of said end portions further having a plurality of segmented and frangible end sections of like outside diameter;

a pair of clamps engageable over selected ones of said segmented end sections for attaching each respective end portion about its opposed pipe end; and

a fastener means operatively associated with each of said clamps for tightening it about the associated end portion and for holding said end portion tightly attached to its associated pipe;

said end portions further each having an inwardly converging tapered internal diameter extending over a length of said end portion substantially equal to the combined length of the segmented end sections.

* * * * *

United States Patent [19]

Kreuz

[11] **4,067,356**

[45] **Jan. 10, 1978**

[54] **CHECK VALVE FOR LARGE CONDUITS**

[76] Inventor: Alfred Kreuz, Hardterwaldstr. 148, 4050 Monchengladbach-Hardt, Germany

[21] Appl. No.: 622,381

[22] Filed: Oct. 14, 1975

[30] **Foreign Application Priority Data**

Oct. 19, 1974 Germany 2449857

[51] Int. Cl.[2] F16K 15/03

[52] U.S. Cl. 137/527; 137/527.4; 137/527.8

[58] Field of Search 137/527, 527.2, 527.4, 137/527.6, 527.8, 543.17, 543.19, 219; 251/298, 219, 228

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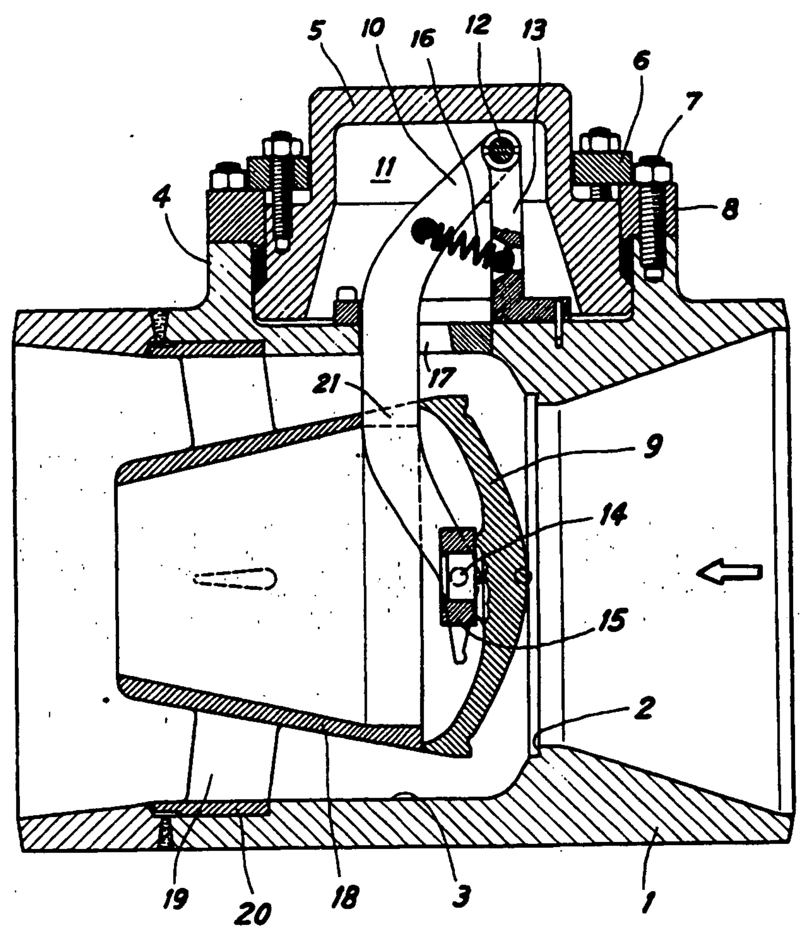
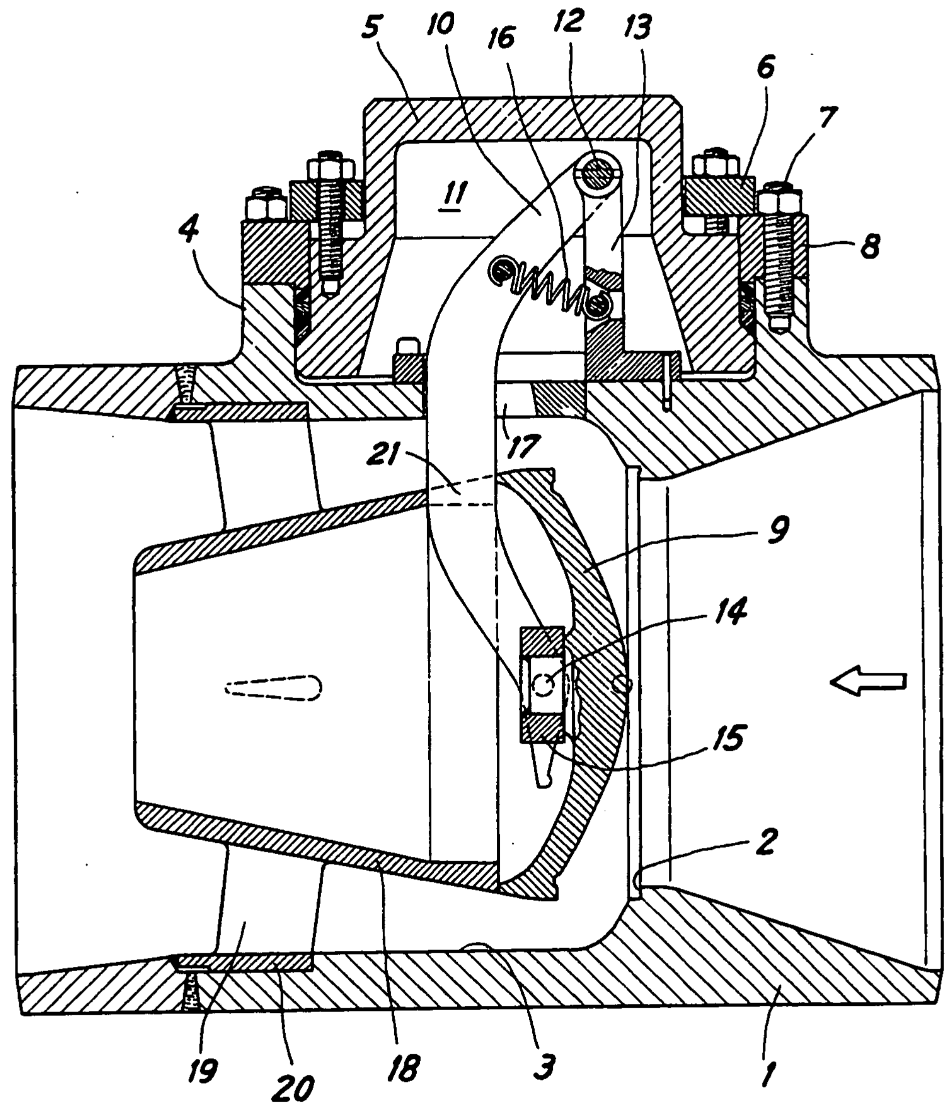
Primary Examiner—William R. Cline
Attorney, Agent, or Firm—Joseph A. Geiger

[57] **ABSTRACT**

A check valve for large conduits having a stationary, rearwardly open hollow valve core mounted inside an enlarged-diameter portion of the housing bore, a matching dish-shaped valve poppet carried by a pivot lever closing the forward end of the valve core in the open valve position in which the valve poppet is spaced a short axial distance from the valve seat, so that a rapid closing action is obtained, as soon as an incipient reverse flow enters the hollow valve core.

9 Claims, 1 Drawing Figure

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CHECK VALVE FOR LARGE CONDUITS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to check valves and back pressure valves, and more particularly to check valves for large conduits where the inlet and outlet openings of the valve are axially aligned and the valve member moves axially in relation to the valve seat.

2. Description of the Prior Art

A check valve in a conduit system is designed to prevent the inversion of the liquid flow, should such an inversion become possible through the failure of the pipe, or through pump failure, for example. In the event of such failure, the check valve has to immediately close the conduit, in response to the cessation of flow, or in response to an incipient reverse flow. Ideally, the operation of a check valve should follow the first of the two conditions, but such an operation requires the presence of a closing bias derived from a spring or from gravity. Such a closing bias, however, will then act as a throttling force against the liquid flowing in the conduit.

In the case of a check valve responding to an incipient reverse flow of the liquid, it is of crucial importance that the response be as rapid as possible. It is well established that a liquid column moving in a pipe under pressure, when subjected to a sudden deceleration, is capable of developing considerable deceleration forces, sometimes as high as several times the operating pressure. Pressure surges of this type are generally undesirable, as they result in uncontrolled stress conditions in the pipe system, including pipe failure under certain extreme conditions.

Known check valves for large conduits are generally of the type featuring an enlarged-diameter housing portion, at the entrance side of which is arranged a radially inwardly narrowed valve seat, a matching axially movable valve member being positioned inside the enlarged-diameter housing portion. In one prior art solution, disclosed in British Pat. No. 336,870, the valve member has the outline of a drop, being carried by a pair of parallel links which are pivoted radially outside the valve diameter, inside a laterally extending head. A counterweight attached to the parallel links applies a closing bias to the valve member. Another prior art valve, described in British Pat. No. 304,751, has a shallow, dish-shaped valve poppet which, in the open position, cooperates with the forward end of a stationary core body to form a drop-shaped centrally located core assembly. The valve poppet is guided for axial motion in relation to the core body, a compression spring urging the valve poppet toward its closed position.

A major shortcoming of the first-mentioned valve is the large inertia of its moving parts. The second prior art valve, though featuring a greatly reduced closing inertia, requires the action of a closing spring. Other prior art solutions have valve members moving along an arc into the open valve position, the latter being located laterally outside the liquid flow. Their closing action is too slow to prevent the establishment of a substantial reverse flow. The result is a sharp pressure surge, when the valve member is closed against its seat.

The requirements in size and response speed of check valves for large conduits have been steadily increasing, due to higher flow speeds and higher operating pressures in the conduits. A good example of this trend is found in the field of thermal power plants, especially atomic power plants. A pipe failure in the main feed pipe of such a power plant, for instance, if not checked by appropriate check valves, can lead to very severe secondary damage in the pipe system. As a result, it has become the practice in this field to specify check valves having a response time of only a few milliseconds.

SUMMARY OF THE INVENTION

Underlying the present invention is the objective of providing an improved check valve for large conduits, the valve being designed for minimal flow resistance and for a rapid closing response.

The invention proposes to attain the above objective by suggesting a check valve with an elongated, generally tubular valve housing with axial inlet and outlet ends, a transversely oriented valve seat in the housing midportion, and an axially open stationary valve core mounted coaxially with an enlarged-diameter bore portion, a dish-shaped valve poppet being arranged in the axial space between the valve seat and the forward end of the valve core, for a short poppet movement between a normal, open positon in which the valve poppet is seated against the valve core covering its forward axial opening and a closed position in which the valve poppet is seated against the valve seat.

In the normal valve position, the liquid accordingly flows through the valve seat, against the open valve poppet, where it is diverted into the annular flow channel surrounding the valve core. After flowing past the stationary valve core, the liquid leaves the valve housing through the axial outlet. When an inversion of the liquid flow takes place, as in the case of a pipe failure, for example, a portion of the rearwardly entering liquid flow enters the open rear end of the valve core moving against the rear side of the valve poppet. This central reverse flow quickly moves the valve poppet against the valve seat.

A preferred embodiment of the invention further suggests that the movable valve poppet be guided by a pivot lever which extends radially outside the bore of the valve housing and which has its outer pivot point located inside a closed lateral head of the housing. The inner end of the pivot lever and the valve poppet thus execute a short arcuate motion, preferably of about 6°, approximating a straight-line axial motion between the open and closed valve positions. In this context, the invention further suggests a pivot connection between the inner extremity of the pivot lever and the valve poppet, thereby making it possible to arrange the valve seat, the valve core front face, and the cooperating front and rear sides of the valve poppet in parallel planes. For this purpose, the pivot lever may have a forked inner end portion, or it may be assembled from two parallel pivot arms, the valve poppet having preferably a central hub extending rearwardly between the arms of the pivot lever.

In the preferred embodiment of the invention, the valve poppet presents a dome-shaped axial contour extending in the direction of the valve seat, thereby smoothly parting and diverting the arriving liquid flow in the direction of the annular flow channel between the valve core and the valve housing.

As an additional advantageous feature, the invention suggests a pivot lever and valve poppet assembly with a combined center of gravity which is located downstream of a radial plane through the outer pivot point of the pivot lever. This means that in the case of a horizontal arrangement of the check valve the weight of the

pivot lever produces a closing bias on the valve poppet. Such a closing bias can alternatively or additionally be obtained by means of a suitable spring engaging the pivot lever.

A preferred embodiment of the invention further features a valve core in the shape of a hollow frustum, the rear diameter of the core being smaller than its forward diameter, yet occupying a substantial portion of the housing bore, in order to allow a central reverse flow to immediately reach the valve poppet through the valve core, for a rapid closing action. The valve core is coaxially positioned inside the valve housing by means of a number of fins extending radially across the annular flow channel between the valve core and the housing wall.

BRIEF DESCRIPTION OF THE DRAWING

Further special features and advantages of the invention will become apparent from the description following below, when taken together with the accompanying drawing which illustrates, by way of example, a preferred embodiment of the invention represented in the sole figure as follows:

The drawing figure shows, in a longitudinal cross section, a check valve for large conduits in accordance with the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In the drawing is shown a check valve for large conduits, intended for high operating pressures. A generally tubular valve housing 1 has axial inlet and outlet openings suited for connection to matching extremities of a pipe system by means of connecting welds, for example. From the inlet side, the housing bore narrows progressively towards a valve seat 2 in the midportion of the housing. Behind the valve seat, the housing bore widens cup-like into an enlarged-diameter cylindrical portion 3. On one side of the housing is arranged a lateral head 4 communicating with the enlarged portion 3 of the housing bore. The lateral head is outwardly closed by means of a head cover 5, preferably of the self-sealing type, as is shown in the drawing. A retaining flange 8, bolted against the valve housing 1 by means of suitable fasteners 7, serves to position and retain the head cover 5. The latter is outwardly preloaded against the retaining flange 8 by means of a pressure ring 6.

A valve poppet 9, corresponding in its outer diameter to the diameter of the valve seat 2, is positioned axially behind the latter. A radially extending pivot lever 10 carries the valve poppet 9, the lever in turn being pivotably supported by its outer extremity on a fixed support 13 by means of a pivot pin 12. The pivot support 13 is mounted in the space enclosed by the lateral head 4 and its cover 5. Between the pivot support 13 and the pivot lever 10 is mounted a tension spring 16 which urges the pivot lever 10 and the attached valve poppet 9 against the valve seat 2. The purpose of this spring is to maintain the valve closed, as long as no liquid flow takes place in the pipe system.

The inner extremity of the pivot lever 10 is attached to the valve poppet 9 by means of a second pivot connection at 14, the pivot axis of the latter being parallel to that of the outer pivot pin 12. The inner pivot connection permits the poppet 9 to align itself with the valve seat 2 in the forward (closed) poppet position and with a matching forward face of a hollow valve core 18 in the rearward (open) poppet position. The two positions

are spaced apart a short axial distance, for a quick closing action of the valve poppet 9. The outer pivot 12 is preferably so positioned that the axis of the inner pivot 14 intersects the valve center axis in both end positions of the valve poppet 9.

The pivot lever 10 has two laterally spaced arms at the pivot connection 14, as part of a forked inner lever portion. Alternatively, the entire pivot lever may be assembled of two laterally spaced parallel arms. The valve poppet 9 has a matching hub 15 extending rearwardly between the arms of the pivot lever 10. Suitable pins or shoulder bolts attach the pivot lever arms to the poppet hub 15.

The housing wall which separates the central housing bore from the cavity of the lateral head is preferably closed by means of a filler member, a slot 17 for the pivot lever movement remaining open. Two narrow slots are necessary in the case of a double-arm pivot lever.

In the center of the cylindrical portion 3 of the valve housing 1 is arranged a tubular valve core 18 in the shape of a hollow frustum. The valve core 18 is fixedly mounted in coaxial alignment with the housing bore, thereby forming a rearwardly widening annular flow channel with the latter. Both axial ends of the valve core 18 are open. However, the larger forward end of the valve core is normally covered by the retracted valve poppet 9, as can be seen in the drawing. The combined outer contour of these parts presents a smooth flow surface for the passing liquid.

The valve core 18 is mounted inside the valve housing 1 by means of a seating ring 20 to which the core is integrally attached through radial fins 19 extending across the annular flow space between the core 18 and the housing 1. The seating ring is suitably recessed in the housing wall. The pivot lever 10, which reaches into the center of the valve core 18, requires a corresponding slot 21 in the forward portion of the latter, two such slots being necessary for a double-arm lever.

The weight of the pivot lever 10, because of the rearwardly corved outline of the lever, tends to assist the tension spring 16 in maintaining the valve closed in the absence of liquid flow. For this purpose, the combined center of gravity of the lever 10 and of the poppet 9 is located downstream of a radial plane through the outer pivot 12 of the lever, when the valve poppet 9 is in the closed position.

It is obvious from the drawing and from the foregoing disclosure that it is possible to replace the pivot lever of the invention with other valve poppet guide means, such as a straight-line guide inside the stationary valve core 18. Also, it is not necessary that the valve housing has axially aligned openings as shown in the drawing; it is possible to accommodate the check valve of the invention inside an elbow-shaped or T-shaped valve housing.

It should therefore be understood that the foregoing disclosure describes only a preferred embodiment of the invention and that it is intended to cover all changes and modifications of the invention which fall within the scope of the appended claims.

I claim the following:

1. A check valve comprising in combination:

an elongated, generally tubular valve housing, the housing bore having an axial inlet end and an axial outlet end adapted for connection to matching openings of a pipe system;

a valve seat defined by a radially inwardly narrowed midportion of the housing bore, in a plane transverse to the housing axis;

an enlarged-diameter bore portion in the housing immediately behind the valve seat;

a hollow stationary valve core positioned coaxially inside the enlarged-diameter bore portion, so as to form an annular flow channel therewith, the valve core having an open forward end facing the valve seat at an axial distance behind it and an open rearward end of a diameter which occupies a substantial portion of the housing bore, thereby forming an inner flow channel through the core, for a reverse flow;

a generally dish-shaped valve poppet arranged in the axial space between the valve seat and the forward end of the valve core, the valve poppet being movable between a normal open position in which it is seated against the forward end of the valve core, thereby covering said open end in the manner of a lid, and a closed position in which it is seated against the valve seat, following a closing motion resulting from a reverse flow of liquid through said inner flow channel; and

means for guiding the valve poppet in its motion between the open and closed valve positions; and wherein

the valve poppet guide means includes an elongated pivot lever engaging with one lever extremity the valve poppet and with the other lever extremity a fixed outer pivot point which is located radially outside the housing bore, so that the valve poppet is guided to execute a short arcuate motion approximating a straight-line axial motion between its open and closed positions; and

the valve housing includes a closed, laterally extending head for the accommodation therein of said fixed pivot point of the pivot lever.

2. A check valve as defined in claim 1, wherein

the valve poppet and the pivot lever extremity by which it is engaged form an inner pivot connection

parallel to the outer pivot connection of the valve lever; and

the open forward end of the valve core and the valve seat are located in parallel planes.

3. A check valve as defined in claim 2, wherein

the valve poppet includes a rearwardly extending central hub;

the pivot lever is constituted by two laterally spaced arms engaging said hub on opposite sides thereof with the aid of pivot members; and

the valve core has matching slots for the accommodation of the pivot lever arms.

4. A check valve as defined in claim 2, wherein

the relationship between the length of the pivot lever and the axial displacement of the valve poppet is such that a closing motion of the latter corresponds to approximately six degrees angular motion of the former.

5. A check valve as defined in claim 1, wherein

the valve poppet has a dome-shaped axially protruding contour presenting a flow-parting nose in the direction of the valve seat.

6. A check valve as defined in claim 5, wherein

the pivot lever and the valve poppet are so designed that their combined center of gravity is positioned a distance downstream of a radial plane through the outer pivot point, when the valve poppet is in the closed position.

7. A check valve as defined in claim 5, wherein

the valve poppet guide means further includes a spring engaging the pivot lever so as to urge the valve poppet towards its closed position.

8. A check valve as defined in claim 1, wherein

the valve core has a smaller diameter at its rearward end, the core having the shape of a hollow frustum.

9. A check valve as defined in claim 8, wherein

the valve core is attached to the housing by means of fins extending radially across said annular flow channel between the valve core and the housing wall.

* * * * *

United States Patent [19]

Kushman et al.

[11] **4,109,819**

[45] **Aug. 29, 1978**

[54] **EXPLOSION VENT AND METHOD OF VENTING**

[75] Inventors: **Robert L. Kushman**, Mason; **Sumy H. C. Ling**, Cincinnati, both of Ohio

[73] Assignee: **The Stacey Manufacturing Co.**, Cincinnati, Ohio

[21] Appl. No.: **797,352**

[22] Filed: **May 16, 1977**

[51] **Int. Cl.**^{2} **B65D 51/16**

[52] **U.S. Cl.** **220/208**; 137/527; 137/535; 220/209; 220/326; 220/331; 220/366

[58] **Field of Search** .... 137/527, 537, 535, 587, 137/527.6; 292/DIG. 65, 219, 64, 71, 78; 220/88 R, 367, 203, 366, 334, 326, 331, 329, 333, 208, 209; 16/182

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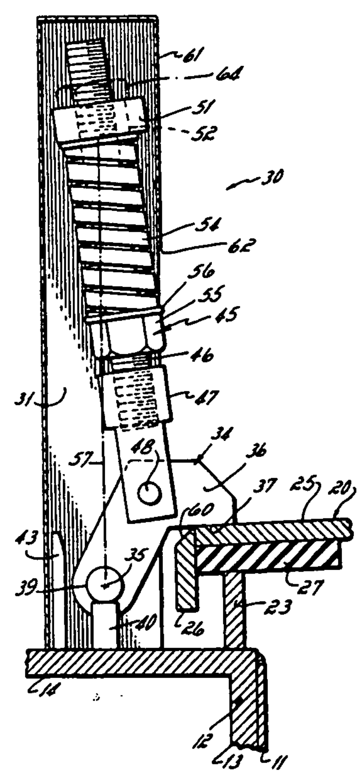
Primary Examiner—William Price
Assistant Examiner—Allan N. Shoap
Attorney, Agent, or Firm—Wood, Herron & Evans

[57] **ABSTRACT**

A quick-release vent structure and method for releasing a rapid pressure buildup within a vessel such as a storage bin. Vent covers are releasably seated over large vent openings presented by framework which is mounted to the vessel. Each cover is resiliently biased in place. Gas pressure in the vessel can lift the cover from the vent opening for pressure relief. If pressure raises the cover a distance greater than a predetermined amount, the biasing force is released from the cover by a quick-release mechanism and the pressure can blow the cover off without damage.

The covers are preferably held in place by spring-loaded, snap action clamps. Each clamp includes a latch member that is pressed against the vent cover by an over-center spring. When the pressure force exceeds the spring force, the latch member is cammed to swing over-center and slides off the cover edge, thereby releasing the cover so that the gas pressure can blow it off and vent extremely rapidly. The covers are easily reseatable, without replacement.

12 Claims, 8 Drawing Figures



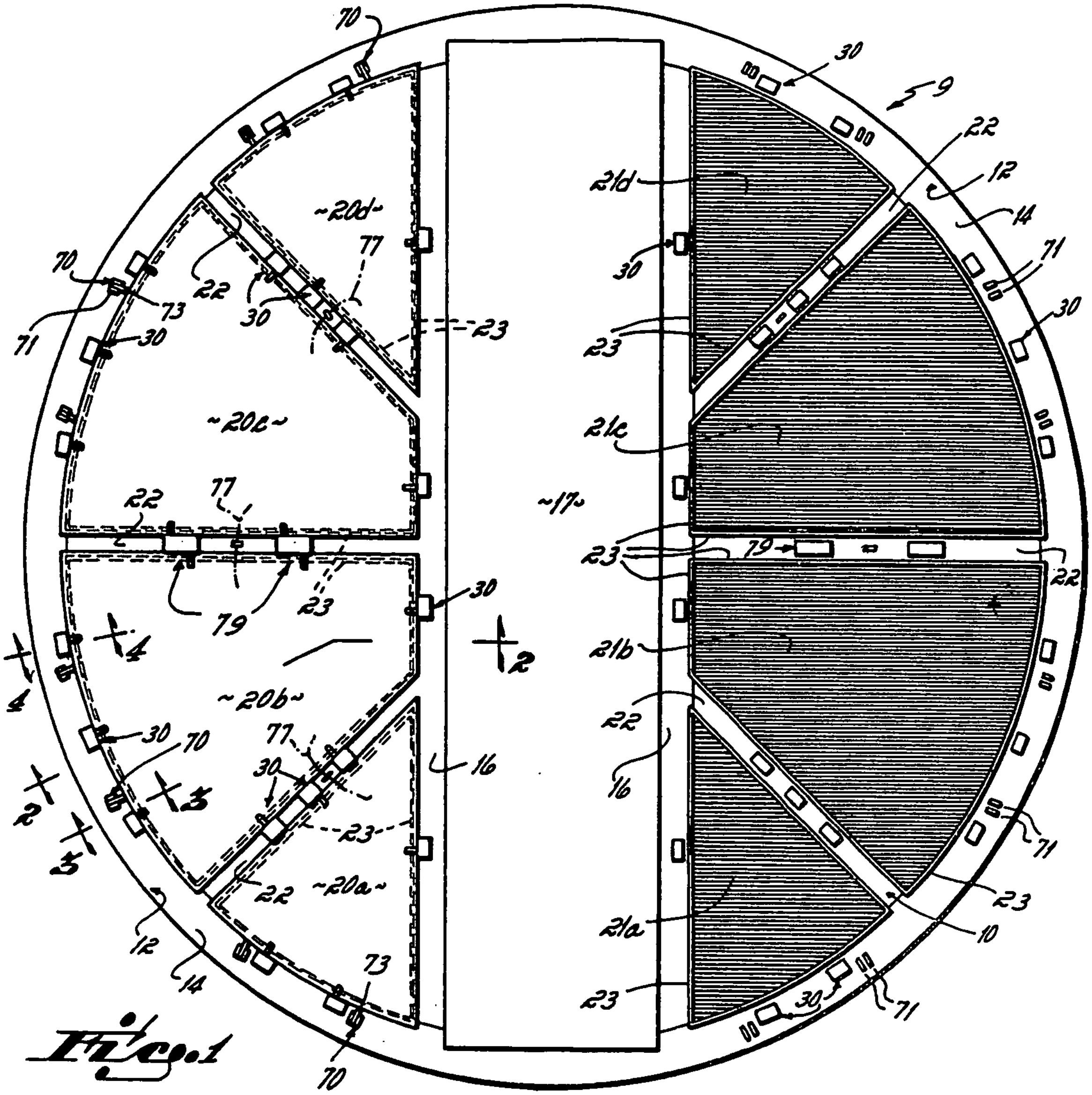


Fig. 1

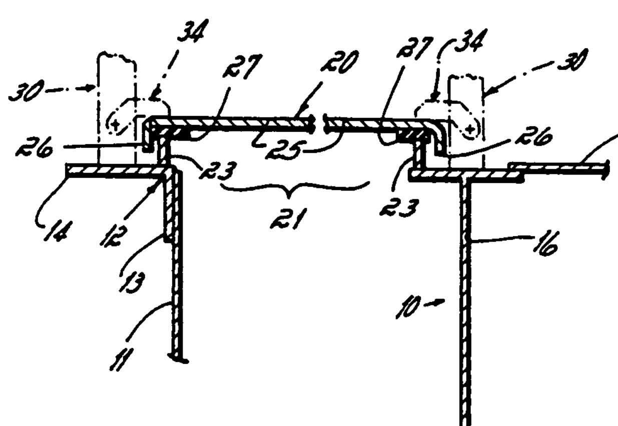


Fig. 2

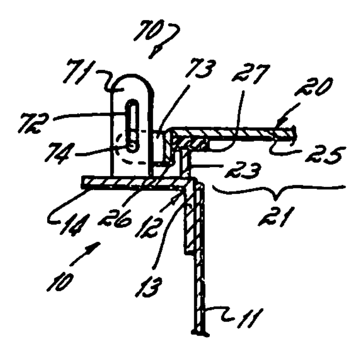


Fig. 3

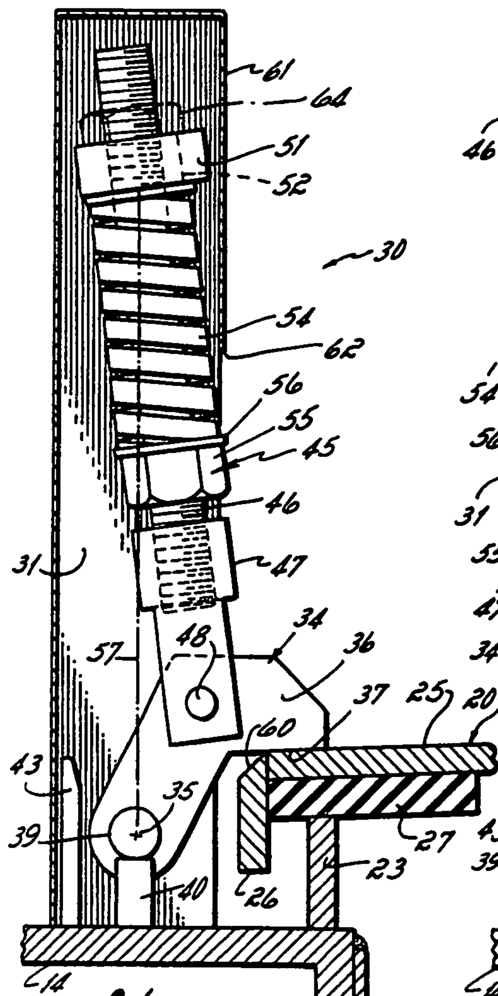


Fig. 4

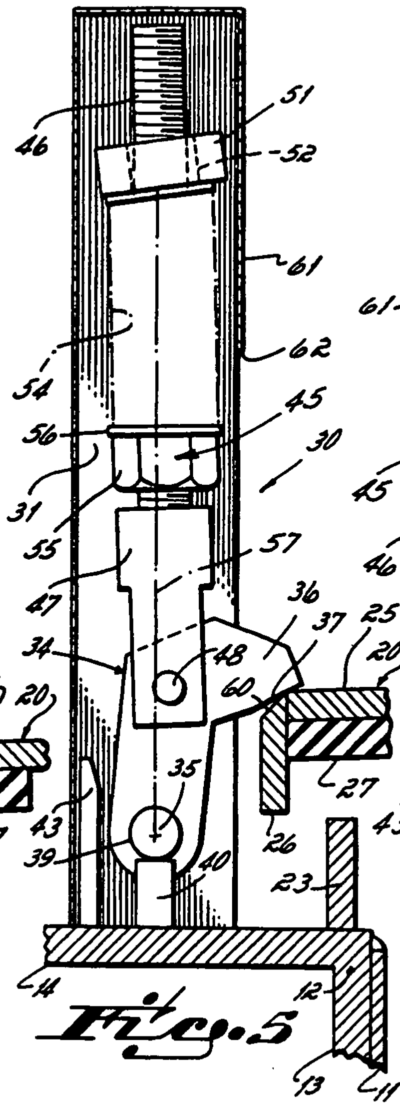


Fig. 5

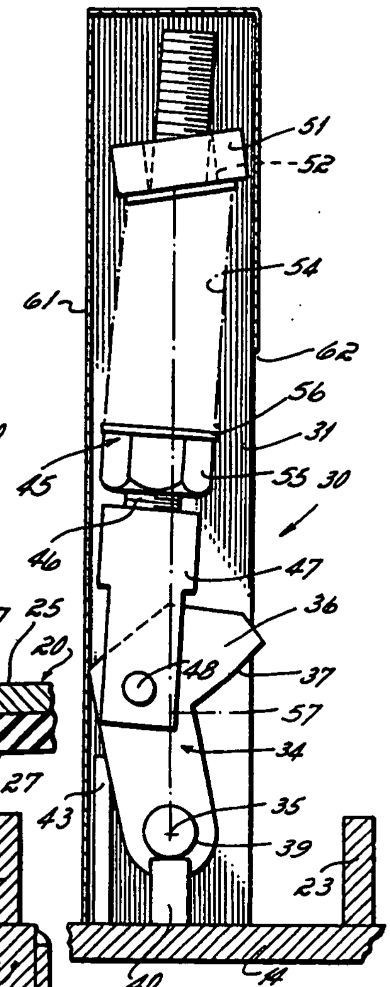


Fig. 6

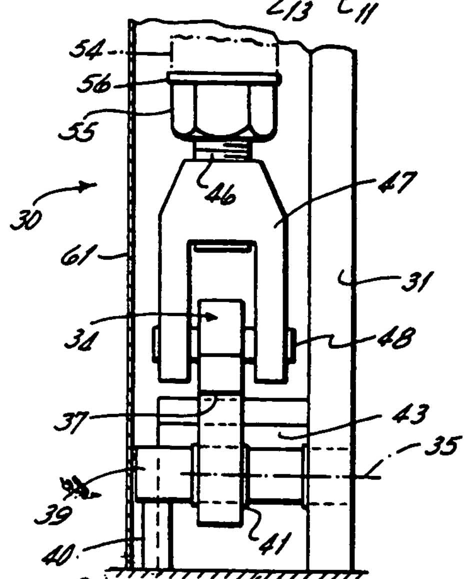


Fig. 7

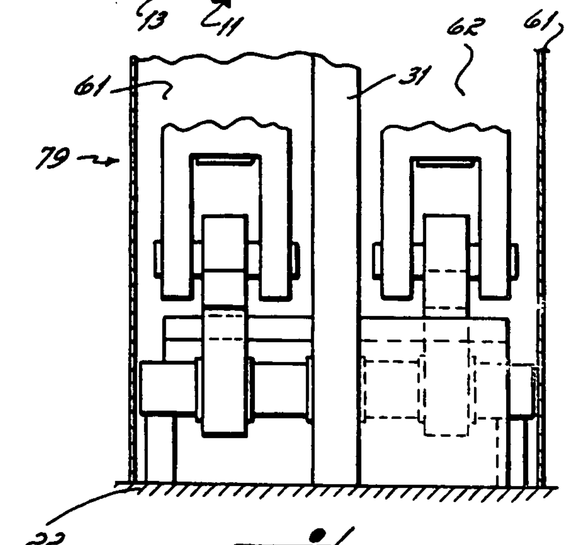


Fig. 8

EXPLOSION VENT AND METHOD OF VENTING

This invention relates to vessels such as bins or silos for storing materials of the type which presents a danger of low level explosion or gas pressure buildup in storage. More particularly, the invention relates to explosion venting whereby such gas pressure may be rapidly vented through a vent opening, without damage to the vent cover or the vessel.

Various materials are subject to some tendency in storage to generate large amounts of gas pressure. Examples of such materials are asphalt, cork, phenol-formaldehyde resins, flour, polypropylene, and coal. While pressure relief valves will safely accommodate a relatively low rate of gas pressure venting, they are insufficient to handle the large pressure rises which such materials sometimes suddenly generate. To handle such conditions it is necessary to provide a vent area which is large in relation to the cross-sectional area of the silo or vessel. This is commonly referred to as "full diameter" or "wide area" venting to connote that the venting takes place over a substantial proportion of the area of the vessel, although not necessarily the full diameter.

THE PRIOR ART

In the past, wide area venting has been accommodated by use of frangible or rupturable diaphragms which will rip or break under sufficient internal pressure, and thereby open a vent for pressure release. Diaphragms of different rupture strengths can be used to set the release pressure at higher or lower levels. Another approach has been to provide a breakable connection between a sealing element and the vent opening. Examples of such frangible or bendable seals and connections are shown in U.S. Pat. Nos. 1,219,493; 2,548,744; 2,868,412; and 2,875,921. It is also known to tack weld explosion roof panels in place by welds which are sufficiently weak to rupture at an abnormally high internal pressure. In that approach it is difficult to assure that a given series of welds will all rupture at the desired pressure; at best it offers only a rough approximation of a desired yield point and, once formed, the welds cannot readily be adjusted or changed to provide a higher or lower yield point. In the event of rupture, field re-welding of the roof panels is required.

U.S. Pat. No. 2,529,329 shows a vent hatch with a disk which holds a gasket against internal pressure. When pressure rises sufficiently, the disk lifts and allows the gasket to rise away from the flange to open an annular vent around the gasket. However, the disk cannot be blown away to open the port for wide area venting.

U.S. Pat. No. 2,169,410 shows a pressure relief hatch on an oil tank which is held down by a spring. The spring applies force until it is compressed "solid", from which point it will yield no further unless it breaks. It does not release the hatch or permit it to be blown off.

U.S. Pat. No. 3,788,514 points out that when a vent cover hold-down spring is fully stressed, once pressure is released the energy stored in the spring can slam the cover down so hard as to cause damage. To overcome that tendency, it teaches a spring which distends inelastically as the vent cover lifts, so that the spring thereafter exerts no substantial closing force. The spring must be replaced after such venting occurs.

In another approach to the problem, releasable vent covers have been held down by spring-loaded fingers which press on the vent cover at a 45° angle to its surface, right at the vent cover edge. As pressure lifts the cover, the fingers slip down the side of the cover, thus releasing it. That arrangement is difficult to set up initially in that it requires careful alignment of the spring loaded fingers to bear diagonally precisely on the edge of the cover. Moreover, it does not permit the cover to lift significantly to release pressure buildup, without releasing altogether.

Whiting U.S. Pat. No. 1,469,567 shows an over-center lever clamp to secure a lid to a container, but the clamp holds the lid closed non-yieldably; the clamp would not open under internal pressure without actually breaking the clamp. No resilient spring force acts to hold the lid closed.

U.S. Pat. No. 2,209,551 shows a spring-biased lever as a latch for a car door, but it is constructed so that it cannot release under internal pressure.

It has been the primary objective of this invention to provide an explosion venting structure with vent covers which will yield elastically to release pressure up to a certain limit without blow off of the vent covers, but which above that limit will release very rapidly, without breakage, to provide venting over a wide area and which, once released, can readily be reset in the field without welding or part replacement. The invention will find use, among other purposes, in silos for the storage of materials such as those listed above, and in other circumstances where venting of rapid pressure rises is desirable. For purposes of illustration it is described hereinafter primarily in relation to storage silo roof structure.

The construction of the basic silo structure itself is not a part of the invention and may be conventional; the explosion roof may release the internal pressure upwardly or laterally, and may be fitted to conventional silo structure.

The explosion vent includes a framework which is mountable to a vessel, for example a roof framework for a silo or storage bin. The framework defines one or more vent openings. Vent covers are releasably seatable on the respective vent openings to close them. Each vent cover has associated with it one or more over-center clamp mechanisms for yieldably holding the cover in place over the respective vent opening to seal it. Each clamp mechanism includes a movable latch member which may be mounted to the framework. Elastic spring means such as a coil spring bears on the latch member. The latch member is movable, preferably pivotally, between a closed position in which the spring urges it to hold the cover on the vent opening, and an open position in which the spring does not so urge it and in which the latch member is clear of the cover so that the cover is free to be blown off. Pressure within the vessel tends to move the cover off the vent opening and to move the latch member, as by camming or pivoting, toward open position. Over-center means snaps the latch member into open position when the cover has been moved a predetermined distance off the vent opening, as by sliding the latch off the edge of the cover, thereby freeing the cover of restraint by the latch.

DESCRIPTION OF THE DRAWINGS

The invention can best be further described by referring to the accompanying drawings, in which:

FIG. 1 is a top plan view of an explosion vent in accordance with a preferred embodiment of the invention, in the form of an explosion roof mounted to a cylindrical silo;

FIG. 2 is an enlarged fragmentary vertical section, partly broken away, taken on line 2—2 of FIG. 1;

FIG. 3 is a fragmentary vertical section, greatly enlarged, taken on line 3—3 of FIG. 1;

FIG. 4 is a fragmentary vertical section, greatly enlarged, taken on line 4—4 of FIG. 1, showing the over-center clamp in the closed position and bearing down on the edge of the vent cover;

FIG. 5 is a section similar to FIG. 4, but shows the clamp approaching center as the cover is lifted to release pressure in the silo, but before the clamp has released;

FIG. 6 is a section similar to FIG. 5, but shows the latch member in the open position;

FIG. 7 is a fragmentary front elevation of the latching end of the clamp, and

FIG. 8 is a fragmentary front elevation of the latching ends of two similar over-center clamps mounted in side-by-side relation on the roof frame, for engaging two separate vent covers.

For purposes of illustration and not limitation, the drawings show an explosion roof for a cylindrical storage bin wherein the roof includes several separate vent covers or roof panels, each of which is releasable, arrayed on each side of a central catwalk. The provision of several smaller releasable roof panels is preferred, in place of a single large panel, because smaller panels offer less inertial resistance and hence can respond more rapidly to a sudden pressure rise. However, it should be understood that the number and shape of the individual roof panels or vent covers themselves is of no particular criticality to the invention. The arrangement shown is referred to as a "full diameter" or "wide area" venting roof, even though that portion of its area covered by the central catwalk is not releasable for venting.

The explosion is designated generally by 9 and includes a framework structure 10 which in use is mounted at the top of the side wall 11 of a storage bin or silo (see FIGS. 1 and 2). The details of the silo construction, apart from the roof, are not part of the invention and may be conventional. The framework 10 preferably includes a peripheral annular flange 12 with a vertical wall 13 which is secured as by riveting to bin side wall 11, and an outwardly projecting horizontal portion 14.

As shown in FIG. 1, the roof framework includes a pair of cross supports 16, 16 which may be I-beams, that extend from one side of the bin to the other, across the middle of the roof, or that tie into other framework. Those beams 16, 16 support a catwalk 17 which provides access to the roof panels for installation and maintenance. The illustrated embodiment has a total of eight vent covers or roof panels, each designated at 20, located on both sides of catwalk 17. The panels 20 close vent openings 21 defined by the roof framework. (In FIG. 1 the roof is shown with four panels 20 *a, b, c* and *d* in place on the roof framework on the left-hand side of catwalk 17, and with the roof panels on the right-hand side removed, showing vent openings 21 *a, b, c* and *d*.) The respective openings 21 are defined by and between the peripheral flange 12, the cross supports 16 and a series of shorter, radially directed braces 22, which are connected between the respective beam 16 and flange 12. As can be seen, the vent openings 21 are generally of pie-shaped configuration, but this shape is not critical. The over-center clamps to be described are desirably mounted to the horizontal flange portion 14 and to the central supports 16.

An upstanding rim 23 is secured to roof framework 10 around the periphery of each vent opening 21. Each roof panel 20 preferably has a generally flat surface 25 and a downwardly turned edge 26 (see FIG. 2), the panel having a width sufficiently great that the edge 26 overhangs opening rim 23. Resilient gasket strips as at 27 may be affixed to the underside of the panel for sealing purposes.

Each roof panel is held down by a series of snap action or over-center clamp mechanisms indicated generally at 30 in the drawings, which are mounted to the roof framework 10 around the periphery of the vent opening. The clamps bear on the top surfaces 25 of the roof panels 20, pressing the gasket strips 27 against the rims 23. The edge 26 acts as a flange to help the respective roof panel carry the pressure load from clamp to clamp. The hold-down force is resiliently applied and, when gas pressure in the vent opening below the roof panel exceeds the total hold-down force, the roof panel will be lifted against the biasing force applied to it by the clamps. The roof panel may be lifted a certain amount without causing the clamps to release (see FIG. 5); that is, the clamps will accommodate some venting without snapping open and disengaging from the roof panel. When, however, the roof panel is raised more than that limited amount, which suitably may be about 1⅛ to 1⅝ inches, the clamps will snap open and altogether release the hold-down force on the panel so that the panel is freed and can be blown off to permit free pressure venting.

In the embodiment shown, these clamps are spaced approximately every 0.83 to 1.75 feet around the periphery of each roof opening, but this spacing depends on internal operating pressure and explosion pressure, and can be changed to suit conditions.

The details of the clamps 30 are shown in FIGS. 4–7. Each clamp is mounted to and supported by a standard or upstanding bracket 31 which is secured as by welding at its lower end to the roof framework 10. A latch member 34 is movably mounted for swinging movement about a horizontal axis 35, parallel to the adjacent roof panel edge 26 (see FIG. 4). Latch member 34 is roughly L-shaped, having a projecting arm portion 36 which presents a latch surface or bearing surface 37 that in use is engaged with and bears downwardly on the upper surface 25 of roof panel 20. Latch member 34 is pivoted for rotation about axis 35 on a shaft 39 which at one end is secured to bracket 31 and at the opposite end is supported on a leg 40 secured to the roof framework. A bearing or bushing 41 may be provided to take the relative rotation between latch member 34 and axle 39 (see FIG. 7).

Latch member 34 is swingable about axis 35 between two positions: a closed position shown in FIG. 4, in which latch surface 37 is engaged with and bears on roof panel surface 25, and an open position shown in FIG. 6 in which the latching member is disengaged from and clear of the roof panel to permit the latter to be blown off the vent opening. In the open position the latch member 34 bears against a fixed stop 43 which is mounted to the roof framework.

Movement of latch member 34 from both the open and the closed positions is resisted by a yieldable, elastic, over-center mechanism designated generally by 45. This mechanism includes a shaft 46 which is threaded at a first or lower end into a clevis 47 which in turn is pivotally connected to latch member 34 by an axle 48 (see FIG. 7) that is parallel to axle 39. At its upper or

second end, shaft 46 passes through a fixed eye 51 which is mounted to bracket 31. Eye 51 has an internal aperture 52 of diameter greater than that of shaft 46, to accommodate the swinging or pivotal movement of the shaft which accompanies latch member movement between the extreme positions of FIGS. 4 and 6. A coil spring 54 is captured on shaft 46 and bears at its upper end against eye 51 through a washer. At its lower end spring 54 bears against a nut 55 on a shaft, through a washer 56. Thus spring 54 biases clevis 47 downwardly, relative to eye 51, acting on the clevis through nut 55 and shaft 46.

It can be seen in FIG. 4 that when latch member 34 is in the closed position, the line of action of spring 54 is directed to the right of an imaginary center line 57 (called the instantaneous axis), which runs between axis 35 and eye 51, so that the spring tends to urge latch member 36 clockwise about axis 35, to urge the roof panel closed. When the latch member is moved across the instantaneous axis 57 toward open position, the line of action reverses, and the spring moves the latch member counterclockwise, against stop 43. Thus, the spring imparts a toggle or snap action to the latch member, such that the latch has two stable positions, one on each side of center; it resists being moved from one side to the other, and once it has crossed center, it tends to remain on that side. The latch member is so configured that when internal pressure lifts the roof panel as shown in FIG. 5, the outer end of arm 36 is cammed to slide toward and (if the lift is sufficient) off the edge of the panel. It is an advantage that until the clamp has released, the cover can reclose the vent if the pressure has been released. Thus in this respect the clamp mechanism has a double function: (1) it permits the cover to lift up to a certain maximum distance to vent pressure, and then to reclose if pressure drops; and (2) when the pressure rise is so rapid, as in an explosion, as to lift the clamp a greater distance, then the cover is released altogether to provide wide area venting for much more rapid release of pressure. The release occurs approximately when shaft 46 crosses instantaneous axis 57, the panel is then freed of the clamp so that it can be blown away by the escaping gas. For improved release it is desirable to provide a chamfer or camming surface as at 60, on the edge of the roof adjacent the area engaged by latch surface 37, to insure smooth release at the edge.

A clamp cap or cover 61 is provided which may be slipped over bracket 31 or otherwise mounted to cover and protect the clamp from weather. This housing has a front opening at 62 which provides clearance for the toggle and latch member, in closed position.

To facilitate field installation spring 54 may be precompressed before mounting, that is, compressed beyond the use amount, and the precompression then removed after the latch member has been seated on the roof panel. For this purpose a precompression nut 64 (shown in phantom lines in FIG. 4) is threaded onto the upper end of shaft 46, above eye 51, to compress the spring between nuts 64 and 55. Pivot axle 48 can then easily be inserted to connect clevis 47 to latch member 36. With a roof panel 20 in place over opening 21 and the latch in the closed position, nut 64 is then backed off, so that the length and hence the compression of spring 54 is determined by the position of nut 55 in relation to eye 51.

In order to provide a greater hold-down force on a roof panel, nut 55 is tightened on shaft 46, i.e., it is moved relatively upward. Such adjustment may be useful to achieve a balance between the hold-down forces of the several clamps acting on a given roof panel, so that all will release at approximately the same instant and thereby prevent unbalanced unlatching of one side of a panel before the other side is unlatched. In this same connection, the spacings of the latches are calculated so that each latch will carry the same load. By reason of the panel configuration, latch spacings may differ around the perimeter of the panel.

It can be seen that the over-center mechanism will accommodate upward movement of the roof panel without unlatching, up to the point that shaft 46 moves over center or until the latching member slides off the edge of the roof panel, whichever first occurs. As the roof panel moves off the vent opening, it increasingly compresses the spring, but as this occurs the effective length of the pivot arm is decreasing at a faster rate than the spring force is increasing. For this reason the hold down force on the panel decreases as the cover is lifted. If the bin internal pressure drops sufficiently by venting through the opening thus provided, the vent will close. However, in the case of an explosion the pressure continues to increase even after the roof panel has been partially lifted, because the venting is not yet sufficient. Once the latch has been moved across center it will remain in the open position shown in FIG. 6, to permit full venting and pressure release. In this connection, it is important to use small, light panels, so that they can be rapidly accelerated by the rapid pressure rise. Their low inertia enables them to be moved out of the way quickly, whereas a panel that is too heavy will not be moved out of the way fast enough and the resulting pressure rise could lead to catastrophic failure of the bin.

By way of particular example, we have used 14 clamps, each having a spring of 4 inch free length and 1470 lbs/inch spring constant, to hold roof panels of 2700 sq. in. area, against an internal pressure of up to about 2 pounds per square inch.

The roof panels may be unattached to the roof so that, once released, they can be completely blown off by internal pressure. However, the force of even a low level explosion may tend to scatter the roof panels dangerously. For this purpose it is desirable to loosely retain the roof panels on the bin, as by hinges and/or chains. A preferred mechanism for doing so, as shown in the drawings, includes the provision of loose or lost motion hinge means as shown in FIGS. 1 and 3. Hinges 70 are mounted aroud the peripheral flange 12 on the roof framework and comprise a pair of parallel spaced upstanding ears 71, each having an elongated vertical slot 72. A tab 73 projects from the adjacent downturned edge 26 of the roof panel, between the two ears 71, and has a stub pin 74 engaged in the ear slots 72. This permits a certain amount of lost motion movement between the roof panel and the hinge such that the roof panel can be lifted in a vertical direction a short distance, suitably 2 to 3 inches, before pivoting movement about pin 74 starts to occur. During this lifting an annular gap is presented between the roof panel 20 and the vent opening rim 23 through which gas pressure is released without necessarily tripping the clamps. As the toggle mechanism is tripped, pin 74 comes into engagement against the upper end of slot 72 and the roof panel begins to swing outwardly about the hinges. The opposite edges of the roof panel may be restrained by chains 77 of sufficient length to permit full venting. The chains run

between the eyes welded to the roof panel, and the framework 10.

After full venting, when the roof panels have been replaced, the clamps can be reset simply by forcing shaft 46 back across center, using a long lever for that purpose.

FIG. 8 of the drawing shows a double clamp arrangement 79 wherein two clamps, each similar to that already described, are mounted side-by-side but facing in opposite directions, on a frame member 22, for engaging adjacent roof panels (see FIG. 1). This arrangement is convenient although not necessary.

Having described the invention, what is claimed is:

1. In an explosion vent for rapidly releasing pressure buildup within a vessel, wherein the vent is of the type including,

a framework mountable to said vessel and defining a series of vent openings,

a series of vent covers releasably seatable on the respective vent openings to close the same,

each vent cover being associated with a series of quick-release clamp mechanisms engaging it around its periphery for releasably holding the cover in place on the respective vent opening,

the improvement in the clamp mechanism comprising,

a latch member connected at one end thereof to said framework by a pivot, said latch member presenting at an opposite end thereof a bearing surface engageable on an edge portion of the respective cover to apply a vent closing force thereon,

said latch member being swingable about said pivot between a closed position, in which said bearing surface bears upon said cover to press the same toward said framework, and an open position in which said latch member is clear of said cover,

a shaft swingably connected at a first point to said latch member between said pivot and said bearing surface, said shaft movably attached at a second point to a support on said framework, the shaft being so mounted that when said latch member is in said closed position said shaft lies on one side of an imaginary line between said pivot and said second point, and on an opposite side of said imaginary line when said latch member is in said open position,

a spring in compression on said shaft and biasing said latch member away from said second point,

the cover being connected to said framework for lineal movement away from the opening,

said spring exerting a biasing force that changes as said cover is lifted from said vent opening by gas pressure in the vessel, said spring yielding in response to gas pressure below said cover, up to a predetermined pressure, without releasing any of the clamp mechanisms, whereby said cover lifts lineally from said vent opening, such lineal movement establishing an annular gap between said cover and vent opening through which gas pressure can vent uniformly around said periphery, said clamp mechanisms remaining engaged with said cover for reseating the cover if said pressure drops,

said spring yielding further to a pressure rise above said predetermined pressure and said latching member moving clear of said cover, to release the same.

2. The explosion vent of claim 1 wherein said vent covers are connected to said framework for movement in a linear direction away from the springs, up to a predetermined distance, and for pivoting movement thereafter.

3. In an explosion vent for rapidly releasing pressure buildup within a vessel, wherein the vent is of the type including,

a framework mountable to said vessel and defining a series of vent openings,

a series of vent covers releasably seatable on the respective vent openings to close the same,

each vent cover being associated with a series of quick-release clamp mechanisms engaging it around its periphery for releasably holding the cover in place on the respective vent opening,

the improvement in the clamp mechanism comprising,

a latch member connected at one end thereof to said framework by a pivot, said latch member presenting at an opposite end thereof a bearing surface engageable on an edge portion of the respective cover to apply a vent closing force thereon,

said latch member being swingable about said pivot between a closed position, in which said bearing surface bears upon said cover to press the same toward said framework, and an open position in which said latch member is clear of said cover,

a shaft swingably connected at a first point to said latch member between said pivot and said bearing surface, said shaft movably attached at a second point to a support on said framework, the shaft being so mounted that when said latch member is in said closed position said shaft lies on one side of an imaginary line between said pivot and said second point, and on an opposite side of said imaginary line when said latch member is in said open position,

a spring in compression on said shaft and biasing said latch member away from said second point, and

lost motion hinge means connecting the cover at one side thereof to the framework for lineal movement from the opening up to a predetermined distance, and for pivoting movement thereafter,

said spring exerting a biasing force that changes as said cover is lifted from said vent opening by gas pressure in the vessel, said spring yielding in response to gas pressure below said cover, up to a predetermined pressure, without releasing any of the clamp mechanisms, whereby said cover lifts lineally from said vent opening, such lineal movement establishing an annular gap between said cover and vent opening through which gas pressure can vent uniformly around said periphery, said clamp mechanism remaining engaged with said cover for reseating the cover if said pressure drops,

said spring yielding further to a pressure rise above said predetermined pressure and said latching member swinging clear of said cover, to release the same.

4. The improvement of claim 3 further wherein said spring is compressed increasingly as the latch is swung about the pivot toward said imaginary line, but at a lesser rate than the effective lever arm is decreased between said first point and said pivot, the hold down force on the cover thereby decreasing.

5. The explosion vent of claim 3 further wherein said edge portion of said cover is a camming surface,

movement of said cover off said opening swinging said latch member about said pivot in a direction that brings said bearing surface toward said camming surface, said camming surface functioning to

disengage said latch member more smoothly from said cover.

6. The explosion vent of claim 5 wherein said camming edge is a chamfered edge.

7. The explosion vent of claim 3 further including precompression means comprising,

an adjustably positionable stop nut on said shaft outward of said second point,

said stop nut preventing said spring from moving said first point more than a fixed distance away from said second point.

8. The explosion vent of claim 3 wherein said vessel is a storage bin and said framework is a roof framework mountable to said bin.

9. The explosion vent of claim 3 wherein the lost motion hinge means comprises a pin movable in slotted members on said framework.

10. The explosion vent of claim 1 wherein said shaft is swingably attached at the second point to a support bracket connected to the framework, by projecting through an eye presented by said bracket.

11. The explosion vent of claim 3 wherein said latch member has an outwardly extending arm which presents said bearing surface.

12. The explosion vent of claim 11 wherein said shaft is connected at said first point to said arm.

* * * * *

United States Patent [19]

Dixon

[11] **4,231,387**

[45] **Nov. 4, 1980**

[54] **BACKFLOW PREVENTING VALVE**

[75] Inventor: **Robert W. Dixon**, Concord, Calif.

[73] Assignee: **Chas. M. Bailey Co., Inc.**, Emeryville, Calif.

[21] Appl. No.: **2,690**

[22] Filed: **Jan. 11, 1979**

[51] Int. Cl.^{3} **F16K 24/02**

[52] U.S. Cl. **137/218**; 137/107

[58] Field of Search 137/218, 102, 107; 251/368

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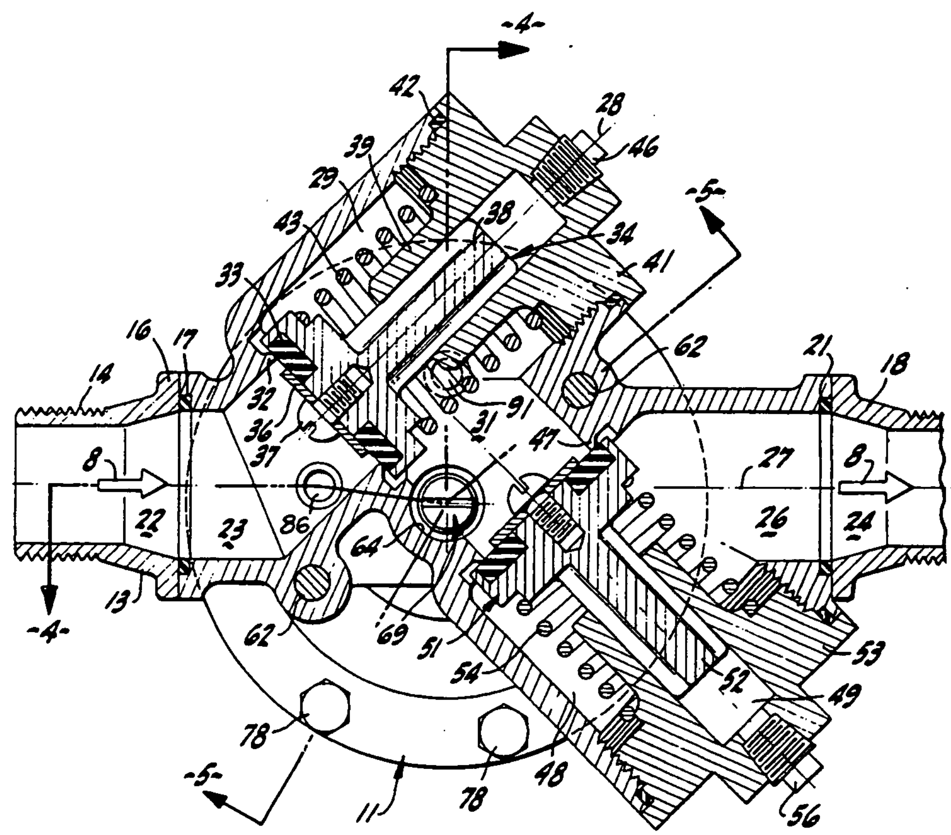
Primary Examiner—William R. Cline
Assistant Examiner—H. Jay Spiegel
Attorney, Agent, or Firm—Lothrop & West

[57] **ABSTRACT**

A backflow preventing valve has a body with two principal portions made of a glass-fiber reinforced plastic. One portion has an inlet port and an outlet port on a through axis, the ports opening to an inlet chamber and an outlet chamber respectively. An intermediate chamber merges with the inlet chamber at an inlet valve seat and also merges with the outlet chamber at an outlet valve seat, the valve axes and the through axis being coplanar. Inlet and outlet poppet valves are urged toward their respective seats by springs in the intermediate and the outlet chambers. There is a vent chamber open to the atmosphere and having a vent valve seat merging with the intermediate chamber. A poppet vent valve has a stem movable in a guide toward and away from the vent valve seat. The stem is abutted by a diaphragm disposed between an outer diaphragm chamber and an inner diaphragm chamber and is pressed by a diaphragm spring in the inner diaphragm chamber. There is a first passage extending through the two body portions between the inlet chamber and the outer diaphragm chamber and a second passage extending through the two body portions between the intermediate chamber and the inner diaphragm chamber.

1 Claim, 5 Drawing Figures



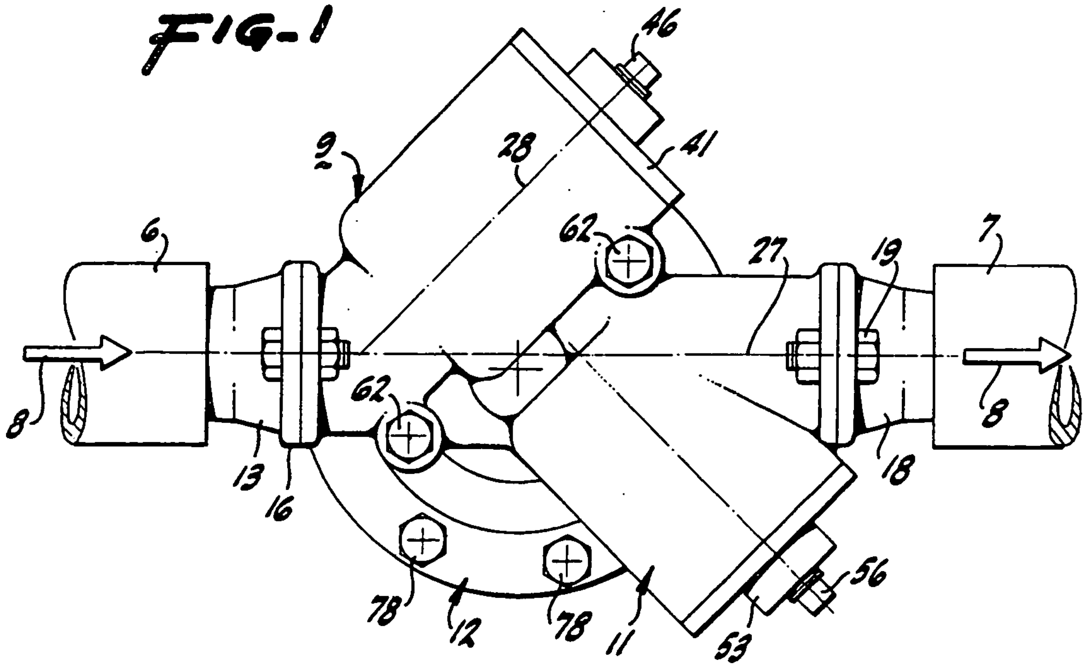

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FIG-1

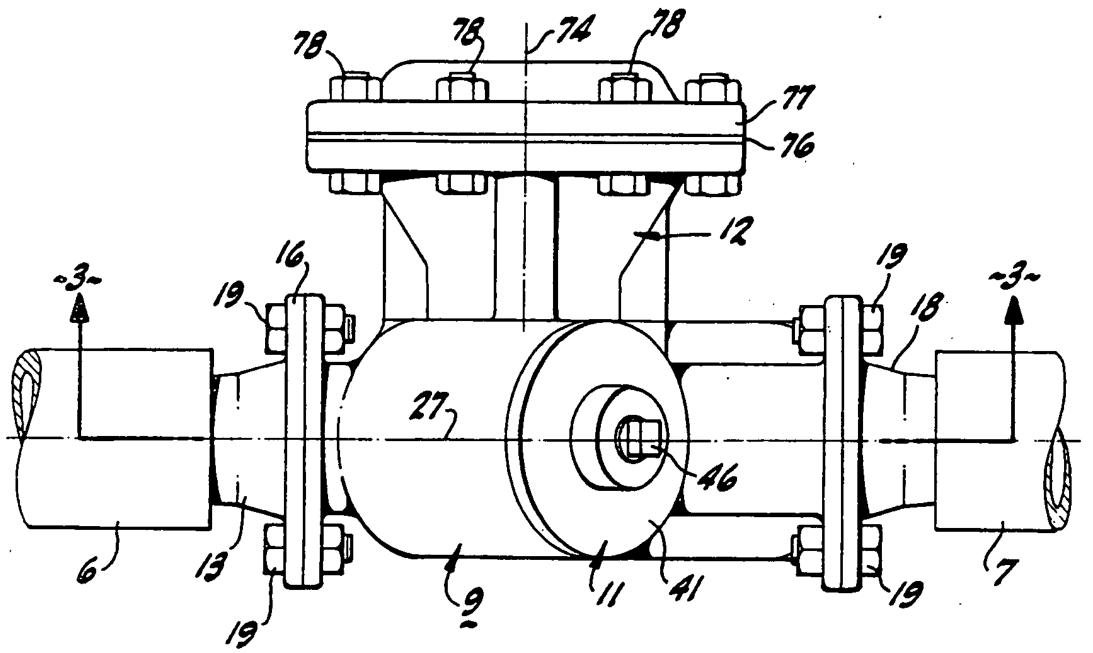
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FIG-2

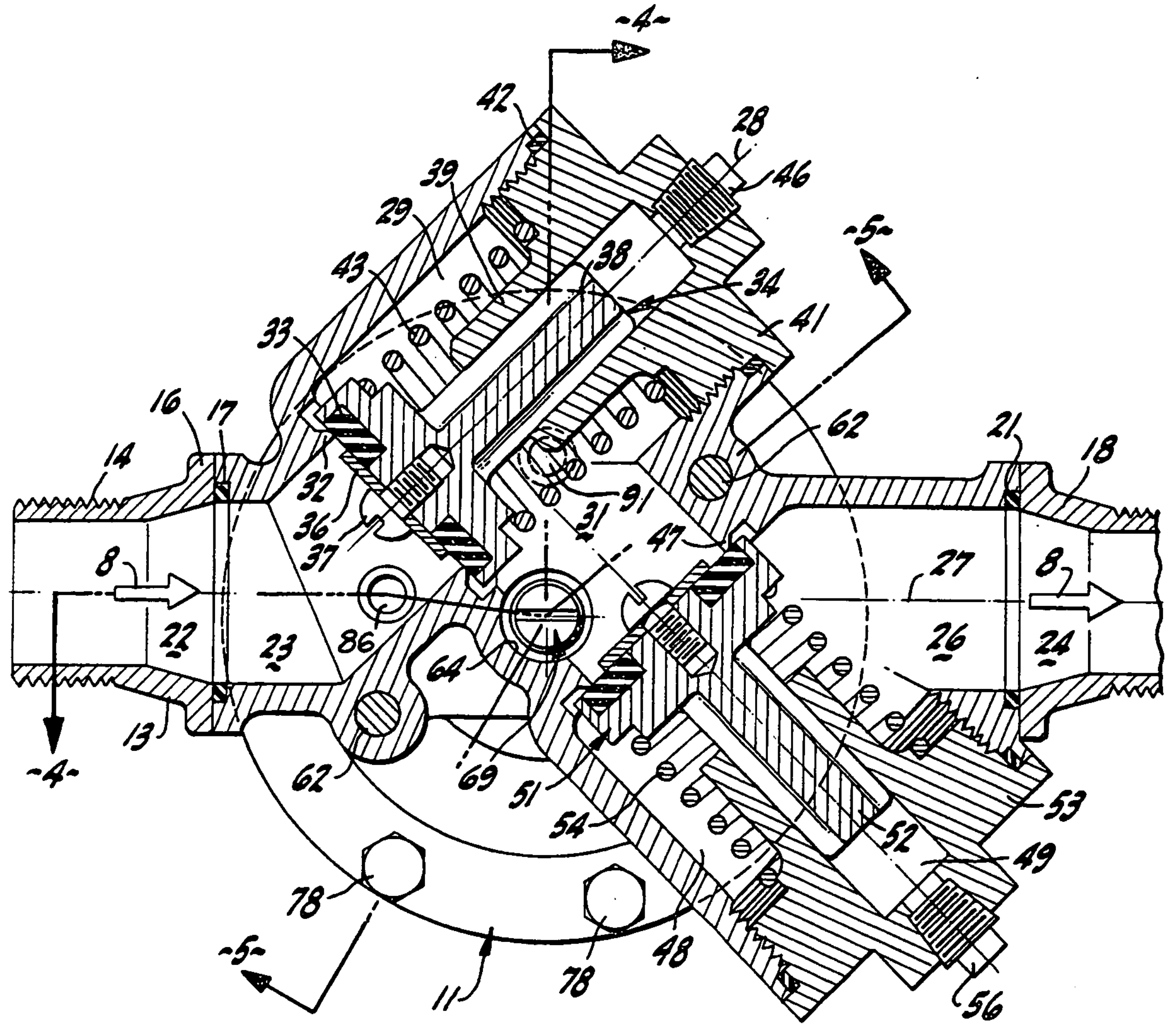
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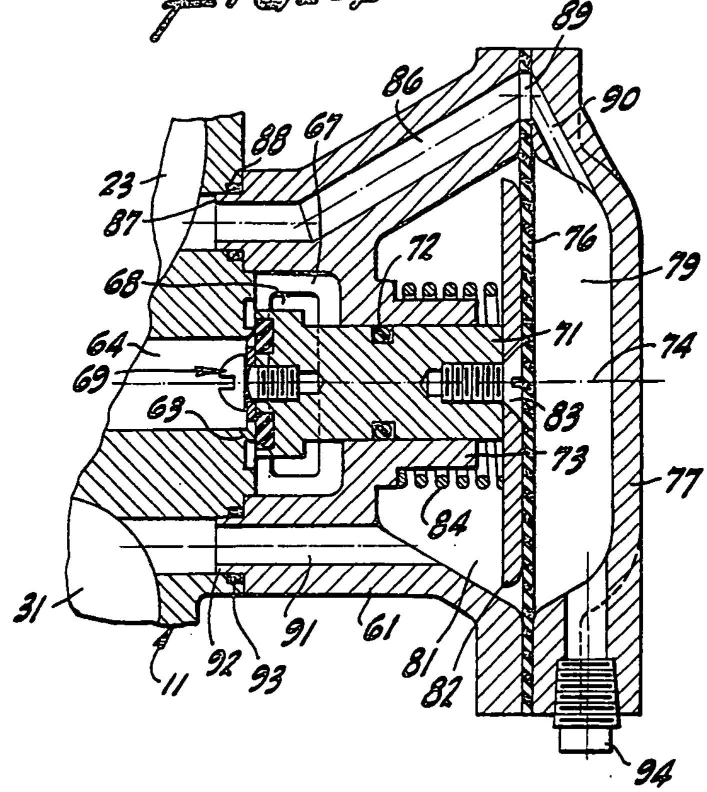
FIG-3

FIG-4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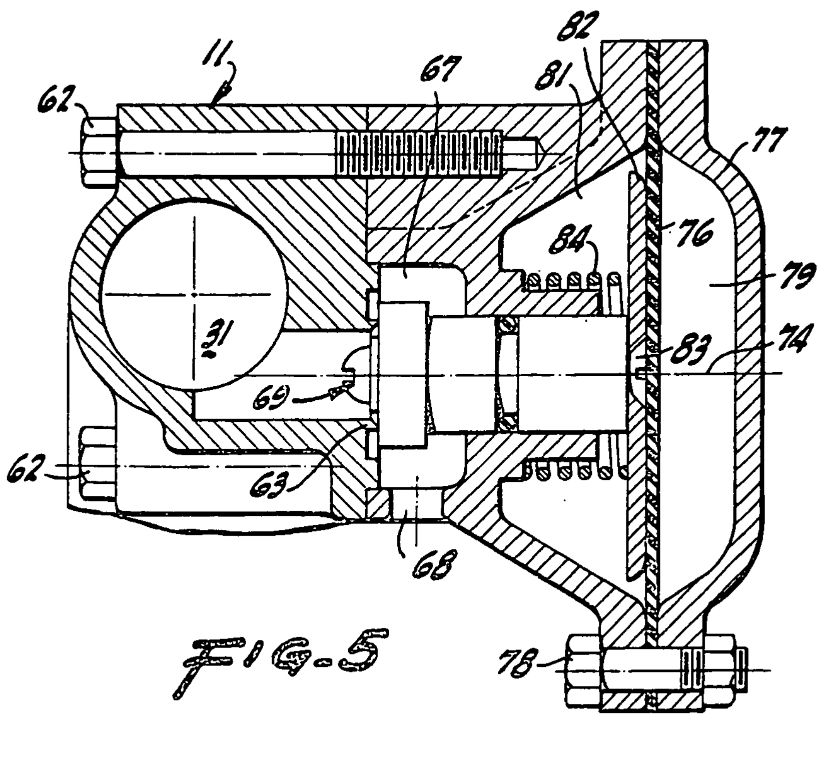
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FIG-5

BACKFLOW PREVENTING VALVE

BRIEF SUMMARY OF THE INVENTION

The backflow preventing valve is for use primarily in domestic water circuits and is effective to preclude flow in a counter direction that might cause contamination. The valve includes a two-part body of glass-reinforced plastic having an inlet valve and an outlet valve in their respective chambers connected to an appropriate inlet port and outlet port. There is an intermediate or vent chamber between the two valves, such chamber being open to the atmosphere under control of a vent valve, the motion of which is controlled by a diaphragm arranged between an inner diaphragm chamber and an outer diaphragm chamber. A spring presses on the diaphragm from the inner diaphragm chamber. There is a pressure connection between the inlet chamber and the outer diaphragm chamber, and there is another pressure connection between the intermediate chamber and the inner diaphragm chamber. The vent valve opens to discharge to the atmosphere in the event pressure on the normally downstream side thereof exceeds the pressure on the normally upstream side thereof.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

FIG. 1 is a side elevation of a backflow preventing valve, pursuant to the invention, incorporated in a fluid line.

FIG. 2 is a plan of the valve installation of FIG. 1.

FIG. 3 is a cross-section, the plane of which is indicated by the line 3—3 of FIG. 2.

FIG. 4 is a cross-section, the plane of which is indicated by the line 4—4 of FIG. 3.

FIG. 5 is a cross-section, the plane of which is indicated by the line 5—5 of FIG. 3.

DETAILED DESCRIPTION

The backflow preventing valve is preferably for incorporation into a fluid system, especially a hydraulic system including a hydraulic high pressure line 6 or pipe normally discharging into a hydraulic low pressure pipe 7 or line. Flow usually is in the direction of the arrows 8 from the high pressure side to the low pressure side. Under abnormal conditions, the pressure on the side 7 may increase substantially and tend, then, to cause flow from the pipe 7 toward the pipe 6. The material that flows backward from the pipe 7 toward the pipe 6 may be contaminated in some fashion and should not be permitted to enter into the line 6. It is in order to prevent such adverse usage and to discharge any such backflowing material that the present valve is employed. Preferably, the valve comprises a main body 9 made up of two principal portions 11 and 12, both preferably fabricated of a nonmetallic material, especially a fiberglass-reinforced plastic that is substantially inert to the atmosphere and to the liquids with which the valve might be utilized and which is adequately capable of withstanding the ordinary operating pressures.

At the inlet end, the device is provided with a special fitting 13 of similar material having threads 14 for connection to the pipe 6 and having a bolt flange 16 for connection to the remainder of the body, there being an intermediate o-ring17 or seal. Similarly, the discharge end is comparably provided with a threaded fitting 18 held in position by bolts 19 and including an O-ring seal 21. With this arrangement, the fittings 13 and 18 can be positioned on the pipes 6 and 7, and the main body can then be inserted laterally therebetween, and finally the flange bolts can be tightened to afford a leak-proof assembly. In this fashion, the assembly and disassembly of the unit with the pipeline can readily be accomplished. Furthermore, simply by changing the fittings 13 and 18, the particular size of pipe to which the unit is to be fastened can be changed.

Within the principal part 11 of the body there is an inlet port 22 opening into an inlet chamber 23. On the other end of the body there is an outlet port 24 opening from an outlet chamber 26, the ports 22 and 24 being in general transverse alignment on a through axis 27 corresponding generally with the axis of the pipes 6 and 7. The inlet chamber 23 is angled or canted to conform to the axis 28 of a portion 29 of an intermediate chamber 31 occupying the central portion of the body. The intermediate chamber portion 29 merges with the adjacent inlet chamber in an inlet valve seat 32 symmetrical with the axis 28 and shaped as an annular rim.

Designed to be seated on the rim is a valve washer 33 held in place on a poppet valve 34 by a washer 36 and a fastening screw 37. The poppet valve includes a cruciform stem 38 movable along the axis 28 within a guide 39. This is in an intermediate chamber plug 41 having a threaded interengagement with the body portion 11 and being surrounded by an O-ring seal 42 to preclude leakage. A spring 43 surrounds the plug and bears against the valve disc so as to urge the disc against its seat with a predetermined degree of force. In one instance, the spring 43 requires a differential pressure across the valve seat 32 of some five or six pounds to open. There is a removable plug 46 which can readily be replaced by a test cock or test gauge for initial testing and for testing from time to time after the unit has gone into service.

The intermediate chamber 31 merges at an outlet valve seat 47 with a portion 48 of the outlet chamber 26, this portion being symmetrical about an axis 49 extending approximately at right angles to the axis 28 and lying in the same plane as such axis and in the same plane as the through axis 27, so that the parts are compact and afford a short fluid travel distance through the valve. Although there is impact of the flowing fluid and any contained particles against the valve washers, such impact is of an angled or glancing nature when the valves are in open position. The short and reasonably direct flow path through the valve body tends to reduce turbulence and eddies within the device and, with the inclined or angled valves, tends to reduce impact wear and abrasion of the valve washers.

Of the same construction as the primary or inlet valve is an outlet valve 51 having a stem 52 guided in a plug 53 situated in the body portion 11 just as is the plug 41. Substantially the only difference is that a spring 54 surrounding the plug 53 is of somewhat lesser strength than the spring 43, responding to a pressure differential of only about two pounds for a full open motion. There is likewise a pipe plug 56 in the body plug 53 in order for a test cock or gauge to be supplied when desired.

As so far described, liquid flowing normally from the inlet toward the outlet is effective to lift the inlet valve 34 to flow into the intermediate chamber 31, then to lift the outlet valve 51 and so to continue through the outlet chamber26 and into the pipe 7. Conversely, if the pressure drop across the valve body should change its direction, then it would be expected that the outlet valve 51 would close, preventing any flow into the intermediate

chamber from the outlet chamber. However, it occasionally happens that under adverse circumstances due to old age or adverse wear conditions or the like the valve 51 cannot be entirely relied upon to seat fully. There is thus some likelihood of leakage past the valve 51 into the intermediate chamber, wherein the pressure could be expected correspondingly to rise to a value greater than that in the inlet chamber 23, so that there might be leakage into the inlet also. This event is to be precluded under any circumstances. Consequently, the valve is supplemented from that as so far described.

Particularly as shown in FIGS. 4 and 5, one principal portion 11 of the valve body is augmented by an abutting portion 61 of the other principal portion 12 thereof. This abutting portion 61 is fabricated of a similar material and is removably assembled with the portion 11 by means of a pair of bolts 62 (FIGS. 3 and 5).

At the junction of the body portions 11 and 61 (FIGS. 4 and 5), there is provided a vent valve seat 63 surrounding an extension 64 of the intermediate chamber, whereas on the other side of the valve seat 63 there is formed in the abutting portion 61 a vent chamber 67 having a vent opening 68 leading to the atmosphere and preferably on the lower side of the vent chamber.

Adapted to seat on the vent valve seat 63 is a poppet vent valve 69 of a construction substantially the same as that of the inlet valve and the outlet valve, but in this instance having an enlarged, cylindrical stem 71 bearing an O-ring 72. The valve stem 71 is designed to reciprocate in a guide 73 projecting from the body portion 61 along the axis 74 of the vent valve. When the valve 69 is closed, there is no flow between the intermediate chamber 31 through the extension 64 into the vent chamber 67 and so through the vent opening 68 to the atmosphere. When the valve 69 is open, then there is easy flow from the intermediate chamber 31 through the next chamber 67 and the opening 68 directly to the atmosphere. The pressure then in the intermediate chamber 31 is substantially atmospheric or slightly thereabove, so that there is no likelihood of any flow from the interior of the body 11 into the inlet line 6, and contamination is therefore completely prevented.

In order to actuate and control the vent valve 69, there is provided a diaphragm 76 of generally planar configuration lying against one face of the body portion 61 and overlain by a diaphragm cap 77 held in position by a number of fasteners 78. The diaphragm is thus well confined and defines an outer diaphragm chamber 79 and an inner diaphragm chamber 81. The stem 71 carries a cap plate 82 secured in position by a fastening screw 83. There is a spring 84 in the inner diaphragm chamber 81 resting against the body portion 61 and against the cap plate 82.

As part of the diaphragm containing structure, including the body portion 61 and the cap 77 there is afforded a first passage 86 extending from the inlet chamber 23 through a sleeve connection 87 surrounded by an O-ring 88 and extending through an aperture 89 in the diaphragm itself. The passage 86 goes an extension passage 90 in the diaphragm cap 77, so that free communication is established between the inlet chamber 23 and the outer diaphragm chamber 79.

In a somewhat similar fashion, there is a second passage 91 partly in the body portion 11 and extending from the intermediate chamber 31 and through a sleeve 92 and O-ring seal 93 and through the rest of the passage 91 in the body portion 12 into the inner diaphragm chamber 81.

With this arrangement, the pressure in the inlet chamber 23 is imposed on the outer side of the diaphragm 76, whereas the pressure in the intermediate chamber 31 is imposed on the under or inner side of the diaphragm 76. This differential pressure, taken into account with the pressure due to the spring 84, either maintains the diaphragm in its position substantially as shown in FIGS. 4 and 5 with the vent valve 69 closed, or under adverse circumstances the pressure inside the intermediate chamber 31, being relatively large, moves the diaphragm away from its position as shown and toward the diaphragm cap 77. This opens the vent valve 69 so that high pressure fluid can discharge from the intermediate chamber 31 through the vent chamber and vent opening 68 to the atmosphere. There is an access plug 94 so that test fixtures or gauges or cocks can be connected into the outer diaphragm chamber 79.

With this arrangement, whenever there is a tendency to backflow due to a higher pressure in the outlet line 7 than there is upstream therefrom toward the inlet line 6, and even though the outlet valve 51 may have become defective and may leak and permit the extra or higher pressure into the intermediate chamber 31, nevertheless the presence of such excessive pressure within the chamber 31 is immediately communicated to the inner side of the diaphragm 76 and augments the pressure thereon due to the spring 84. If, then, the pressure on the other, outer side of the diaphragm in the outer chamber 79 and communicated thereto through the first passage 86 is still relatively low, then the differential pressure opens the vent valve 69 and permits all of the fluid downstream from the inlet valve 34 to discharge to the atmosphere through the vent opening 68, and there is no possibility of back or contaminating flow to the inlet pipe 6. When the differential pressure drops to a normal valve, the parts return to their normal, illustrated positions.

With this arrangement, and since the valve is expected to serve for many years, it is quite possible at any time simply by removing the various bolts, such as 19, and very slightly spreading the pipes 6 and 7 to withdraw the backflow preventing valve laterally for bench tests or the like. Equally simply, a properly conditioned valve can be reintroduced into the line and again bolted in position for further service. Also, because of the various plugs, the valve can be checked at any time by appropriate test techniques to make sure that it is in full and effective service operation.

Since the body of the valve is comprised of nonmetallic materials, there is no transmission of electrical voltages across or through the valve, so that some of the possible bad effects of electrolysis are greatly reduced. Furthermore, since the valve is of a plastic material that partakes of a very smooth surface finish, the pressure drop through the valve is somewhat less than is customary. Also, since the main body of the valve is made in two principal portions, the entire interior of the valve is subjected to ready access and complete and thorough visual inspection at all times. There has therefore been provided a relatively simple, economical and superior backflow preventing valve.

I claim:

1. A backflow preventing valve comprising a first body portion terminating in a predetermined planar face, said first body portion having an inlet port and an outlet port both in alignment on a through first axis extending in a plane parallel to said planar face, means defining an inlet chamber in said first body portion open

to said inlet port and also extending along a second axis disposed in said plane and intersecting said first axis, means defining an outlet chamber in said first body portion open to said outlet port and also extending along a third axis disposed in said plane and intersecting said second axis, means defining an intermediate chamber in said first body portion merging with said inlet chamber at an inlet valve seat centered in said plane and also merging with said outlet chamber at an outlet valve seat in said plane, an inlet valve in said intermediate chamber and having a valve stem movable in said plane toward and away from said inlet valve seat, a first spring in said intermediate chamber urging said inlet valve toward said inlet valve seat, an outlet valve in said outlet chamber and having a valve stem movable in said plane toward and away from said outlet valve seat, a second spring in said outlet chamber urging said outlet valve toward said outlet valve seat, a second body portion terminating in a predetermined planar face, means for releasably holding said first body portion and said second body portion with said planar faces substantially coincident and parallel to said plane, means defining in said first body portion an extension of said intermediate chamber disposed substantially perpendicular to said plane, means in said first body portion defining a vent valve seat surrounding said extension and substantially parallel to said plane, means defining in said second body portion a vent chamber extending perpendicular to said first plane and merging with said extension, means defining a vent to the atmosphere from said vent chamber, a vent valve having a stem movable in said extension normal to said plane and having on said stem a head movable into and out of engagement with said vent valve seat, a planar cap plate on said vent valve stem and extending parallel to said plane, a spring interposed between said second body portion and said cap plate for urging said vent valve away from said vent valve seat, a planar diaphragm extending parallel to said plane and abutting said cap plate and said second body portion, a diaphragm cap overlying said planar diaphragm on the side thereof opposite said cap plate and thereby establishing a diaphragm chamber, means for securing said diaphragm cap through said planar diaphragm to said second body portion, and means for establishing an air passage substantially normal to said first plane and extending from said inlet chamber then through said first body portion and then through said second body portion and then through said diaphragm and said cap into said diaphragm chamber.

* * * * *

United States Patent [19]

Griswold

[11] **4,276,897**

[45] **Jul. 7, 1981**

[54] **BACKFLOW PREVENTION APPARATUS**

[75] Inventor: **David E. Griswold**, Corona Del Mar, Calif.

[73] Assignee: **Griswold Controls**, Irvine, Calif.

[21] Appl. No.: **121,156**

[22] Filed: **Feb. 13, 1980**

Related U.S. Application Data

[63] Continuation of Ser. No. 918,646, Jun. 23, 1978, abandoned.

[51] **Int. Cl.**[3] **F16K 17/02**

[52] **U.S. Cl.** **137/218**; 137/107; 137/484.2

[58] **Field of Search** 137/107, 218, 484.2

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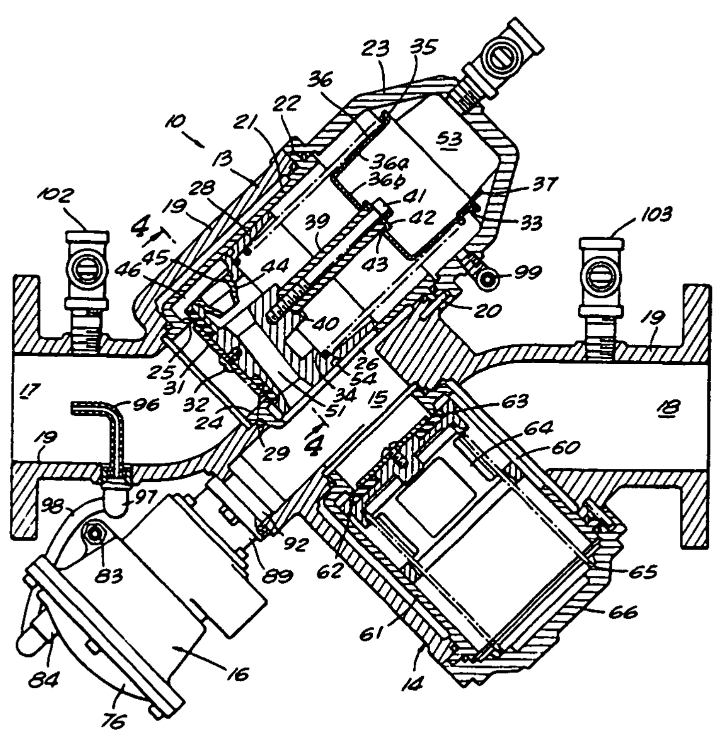
Primary Examiner—Gerald A. Michalsky
Attorney, Agent, or Firm—Lyon & Lyon

[57] **ABSTRACT**

Two check valves in series with a zone between them are mounted between the supply pipe and discharge pipe, and a relief valve vents the zone to atmosphere under predetermined pressure conditions in the pipes. A valve poppet in the upstream check valve cooperates with its seat and an enclosing stationary barrel to form a first chamber. A second chamber is formed in the barrel on the other side of the valve poppet, and a third chamber is formed downstream of the valve poppet and the barrel, and constitutes the zone to be vented. An ejector nozzle receives liquid from the first chamber when the valve poppet is open, and discharges it into the zone. The action of the ejector nozzle aspirates the second chamber in the upstream check valve to reduce the pressure drop when the valve is open. The velocity head of the discharge from the ejector nozzle is directed against a valve poppet in the downstream check valve, which also includes a pressure affected piston area. In each check valve the flow restriction across the valve seat decreases more rapidly than the downstream flow restriction. Also, the outer surface of the valve poppet in the upstream check valve defines, with its stationary barrel enclosure, a series of ribs and cavities which direct flow of fluid from the check valve through the ejector nozzle while minimizing flow into the aspirated chamber. A relief valve device connected to vent the zone to atmosphere has a valve stem subjected to a pressure differential between the inlet pressure to the upstream check valve and the reduced pressure in its aspirated chamber.

17 Claims, 6 Drawing Figures



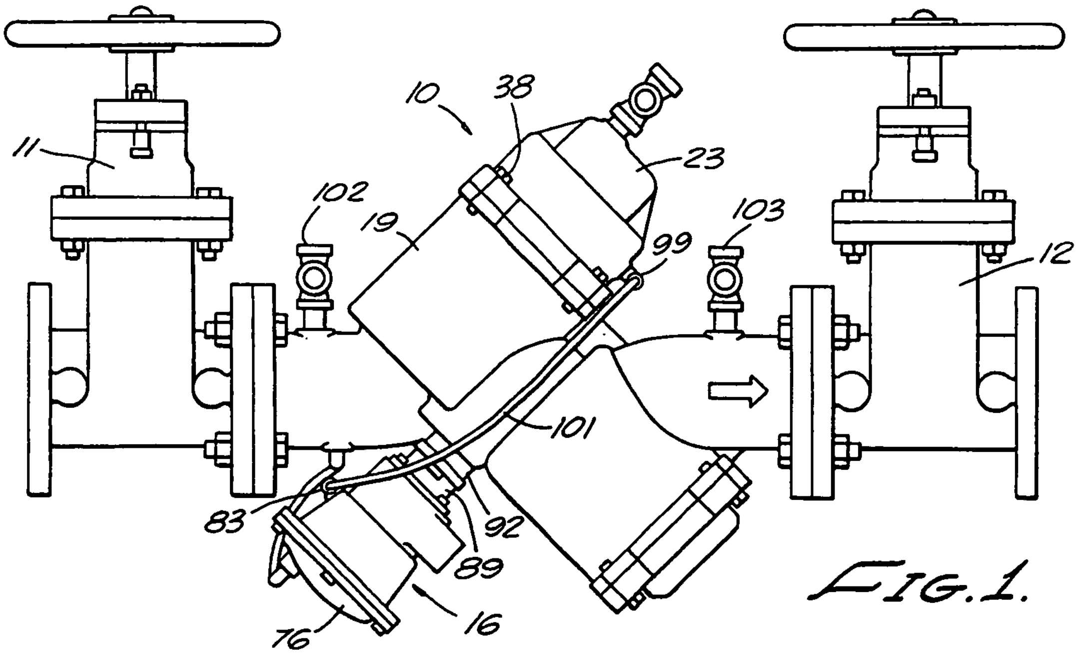

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FIG. 1.

FIG. 5.

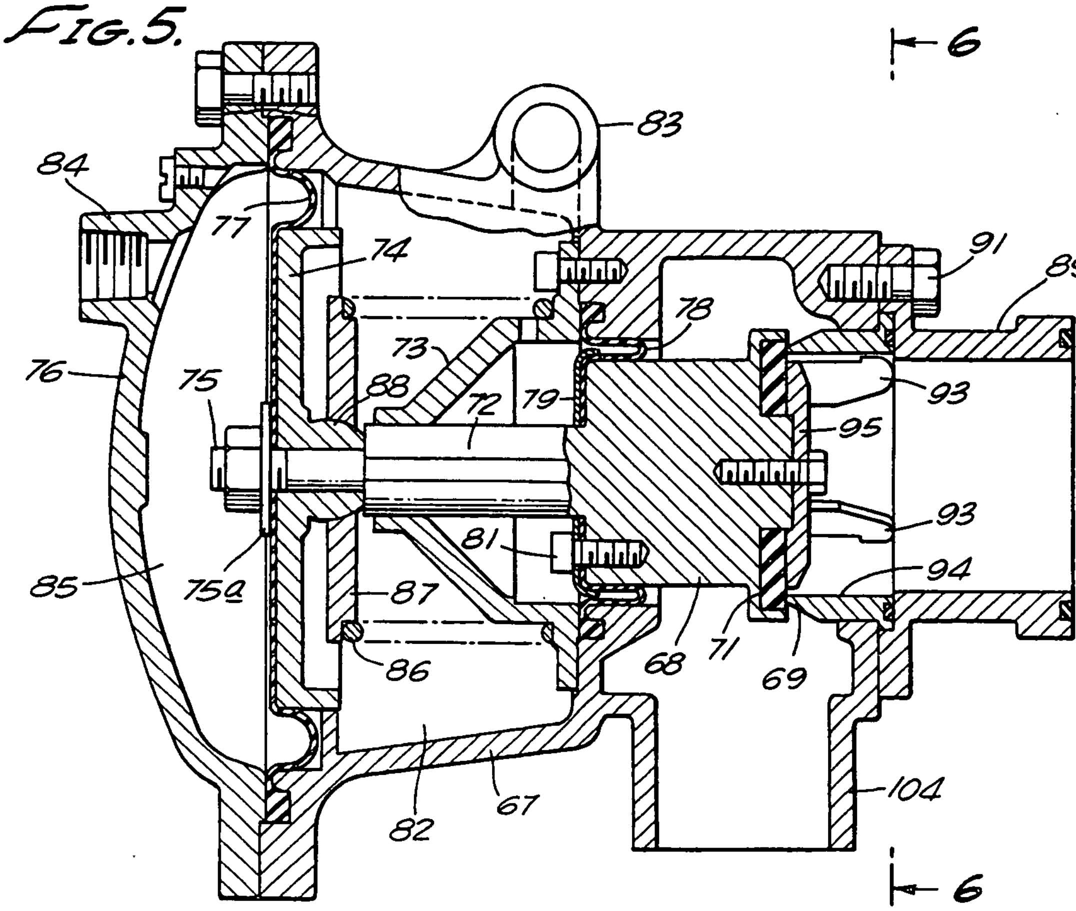
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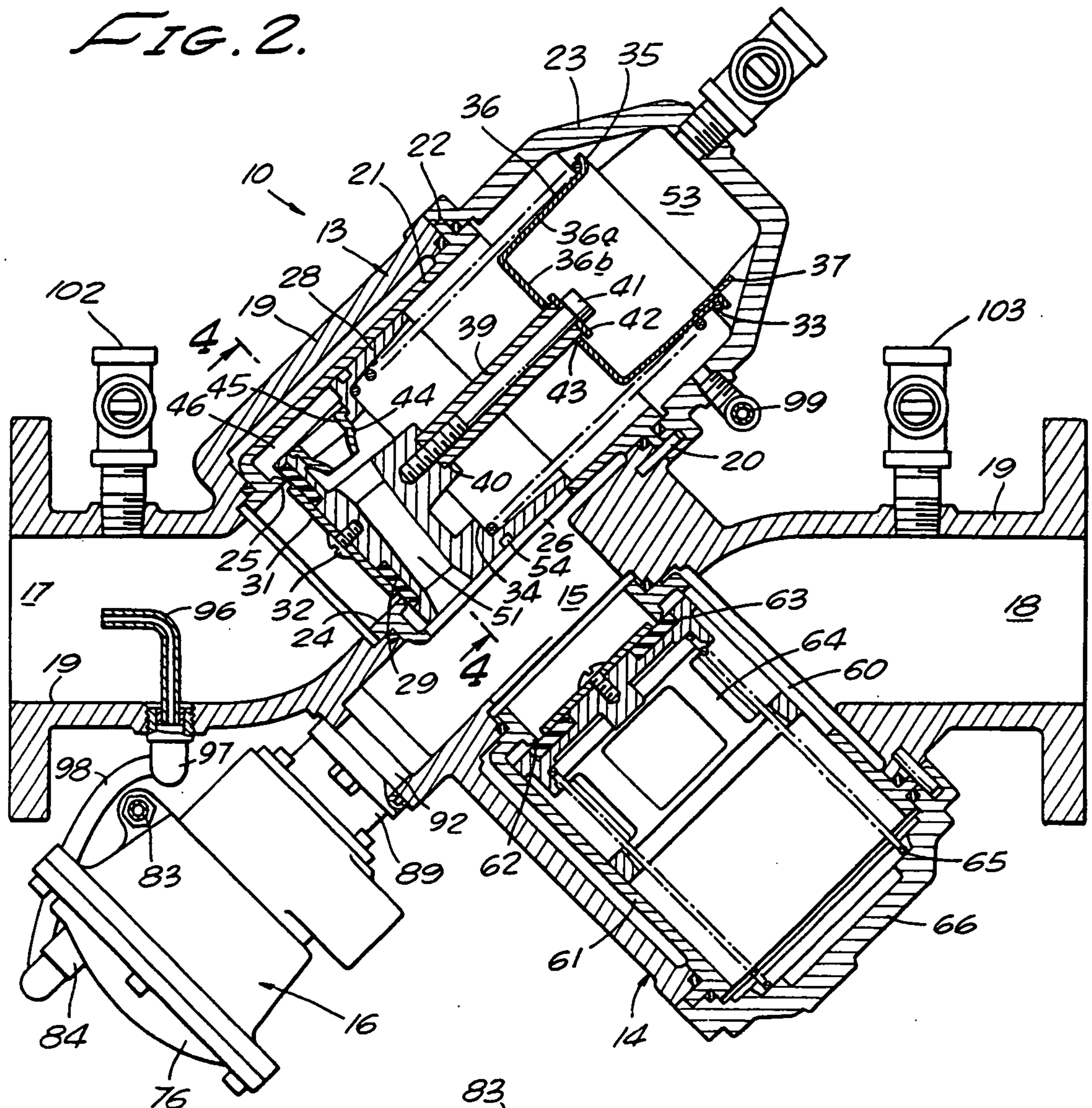
FIG. 2.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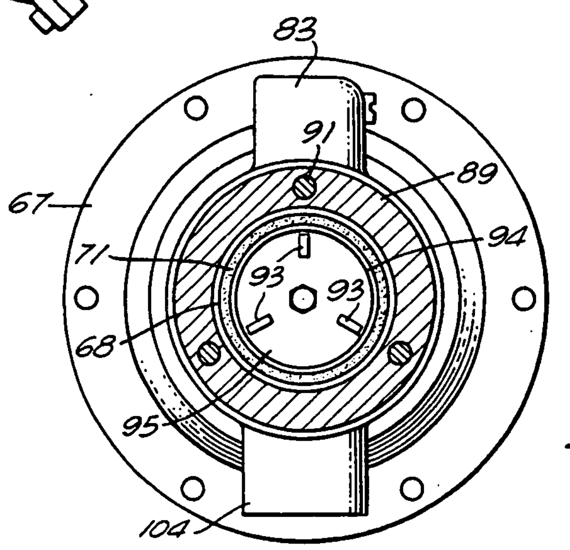
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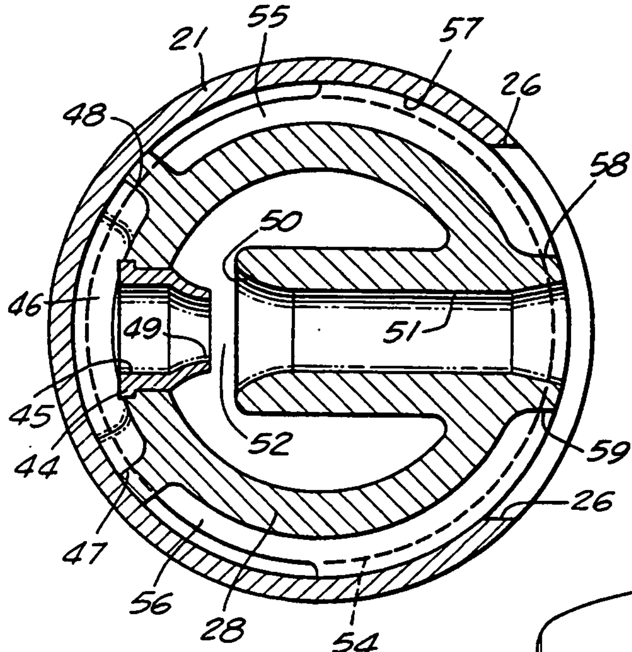
FIG. 6.

FIG. 4.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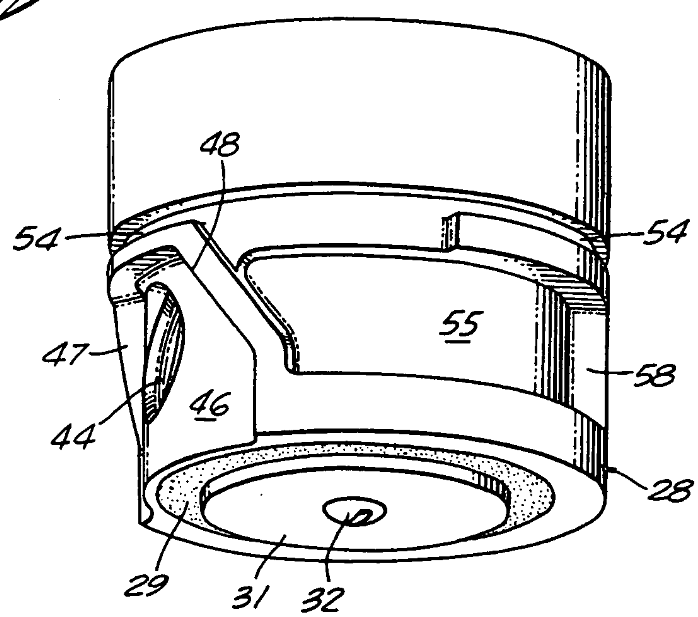
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FIG. 3.

BACKFLOW PREVENTION APPARATUS

This is a continuation of application Ser. No. 918,646, filed June 23, 1978, now abandoned.

This invention relates to backflow prevention apparatus to be installed between a supply pipe and a discharge pipe. Such devices are commonly used in water supply systems in order to insure that polluted water in a discharge pipe cannot flow in a reverse direction into a supply pipe. Such apparatus commonly employs an upstream check valve and a downstream check valve with a zone between them, along with a relief valve operated by differential pressure for venting the zone to atmosphere whenever the discharge pressure approaches the supply pressure within predetermined limits.

In accordance with this invention, the intensity of pressure in the supply pipe must be reasonably high in order to begin opening movement of the upstream check valve against the action of a load spring. Once the opening movement has begun, a larger area is presented to the upstream pressure with the result that the check valve opens to a greater degree. Flow through the upstream check valve passes through a first chamber and through an ejector nozzle which increases the flow velocity, while reducing its pressure. The discharge from the small end of the ejector nozzle passes through a space which communicates with a second chamber within the check valve assembly which is separated from the incoming flow by sliding contact of the valve poppet within a stationary barrel. The aspirating effect of the high velocity flow reduces the pressure in the second chamber so that the effective force of the load spring is reduced. The result is that very low pressure drop takes place through the upstream check valve when it is open. The ejector nozzle discharges into a third chamber which constitutes the zone between the check valves.

Another feature of the invention resides in the fact that the relief valve assembly for venting the zone to atmosphere operates on differential pressure between inlet pressure in the supply pipe and reduced pressure in the aspirated second chamber in the upstream check valve assembly. In addition, the velocity head is added to the inlet pressure in the supply pipe.

Other and more detailed objects and advantages will appear hereinafter.

In the drawings:

FIG. 1 is a side elevation showing a preferred embodiment of this invention.

FIG. 2 is a sectional elevation showing a portion of FIG. 1.

FIG. 3 is a perspective view showing the valve poppet employed in the upstream check valve assembly.

FIG. 4 is a transverse sectional view of the valve poppet shown in FIG. 3, taken substantially on the lines 4—4 as shown in FIG. 2.

FIG. 5 is a sectional elevation of the relief valve assembly.

FIG. 6 is an end view of the relief valve assembly taken substantially on the lines 6—6 as shown in FIG. 5.

Referring to the drawings, the backflow prevention device generally designated 10 is positioned between two conventional gate valves 11 and 12. The gate valve 11 forms a part of a water supply pipe, and the gate valve 12 forms a part of a water discharge pipe. The

device 10 prevents flow of water from the discharge pipe back into the supply pipe.

As shown in FIG. 2, the device 10 includes an upstream check valve assembly generally designated 13, a downstream check valve assembly generally designated 14 having a zone 15 between them. A relief valve assembly generally designated 16 vents the zone 15 to atmosphere whenever the pressure in the aspirated second chamber 53 approaches the pressure in the inlet passage 17, within predetermined limits. The passages 17 and 18 and the zone 15 are all formed within the integral body 19. The upstream check valve assembly 13 and the downstream check valve assembly 14 are mounted in the body 19 at right angles to each other, and each is positioned at an angle of 45 degrees to the aligned axes of the inlet and outlet passages 17 and 18.

The upstream check valve assembly 13 includes a stationary barrel 21 mounted within the body 19 and having a flange 22 clamped between the body 19 and the stationary cover 23. An alignment pin 20 assures the proper orientation of the barrel 21 within the body 19. One end of the barrel 21 has a circular opening 24 defined within a stationary annular seat 25. The barrel 21 has a side window 26 communicating with the zone 15.

A valve poppet 28 is slidably mounted in the barrel 21 for movement toward and away from the stationary seat 25. The valve poppet 28 is provided with an annular resilient disk 29 which cooperates with the seat 25 to form a bubble tight seal. A retainer plate 31 holds the resilient disk in position and is itself fixed to the valve poppet 28 by means of the screw 32. A coil compression spring 33 has one end seated against the internal shoulder 34 of the valve poppet 28 and the other end engaging an end flange 35 on the spring retainer 36. The spring 33 encircles the tapering portion 36*a* of the retainer. A key 37 prevents turning of the retainer within the cover 23, which cover is secured to the body 13 by means of threaded fastenings 38, as shown in FIG. 1. A central non-circular tubular stem 39 is secured to the valve poppet 28 by means of the threaded element 41 and washer 42, and slides through a notched non-circular opening 43 in the radial portion 36*b* of the spring retainer 36. The stem 39 is received into a matching recess 40 in the valve poppet 28. The valve poppet 28, stem 39, element 41, washer 42, retainer 36 and spring 33 constitute a unitary assembly for installation into position, in the absence of the cover 23. For safety reasons a special tool is required to engage the threaded element 41. The assembly of cover 23 to the body 13 causes the spring 33 to be further compressed beyond its relaxed position.

An ejector nozzle 44 is mounted on the valve poppet 28 and has a relatively large entrance opening 45 communicating with the first chamber 46 defined between the valve poppet 28 and the barrel 21 and between the ribs 47 and 48. The discharge opening 49 is smaller and is directed toward a transverse passage 51 in the valve poppet 28 but which is separated therefrom by the space 52. The space 52 communicates with a reduced pressure second chamber 53 containing the spring 33. This second chamber 53 extends into the upper portion of the barrel 21 and into the cover 23 both inside and outside of the spring retainer 36.

A circumferential groove 54 is formed in the outer cylindrical surface of the valve poppet 28, and this groove 54 is interrupted at two locations to communicate with the arcuate spaces 55 and 56 formed in the outer surface of the valve poppet 28 and bounded by the

interior surface 57 of the stationary barrel 21. The arcuate space 55 extends from the rib 48 to the rib 58, and the arcuate space 56 extends from the rib 47 to the rib 59. Both of these arcuate spaces 55 and 56 communicate with the window opening 26 in the barrel 21. As best shown in FIG. 4, the transverse passage 51 in the valve poppet 28 discharges through the center of the window opening 26 in the stationary barrel 21 into the zone 15.

The downstream check valve assembly 14 is similar to the upstream check valve assembly 13 in many respects except that it does not have an ejector nozzle 44 or a transverse passage 51. The stationary barrel 61 carries the stationary annular seat 62 which is engaged by the resilient disk 63 carried on the valve poppet 64. The coil compression spring 65 engages the cover 66 at one end and engages the valve poppet 64 at the other end. The cover 66 and the barrel 61 are secured to the body and aligned in the manner described in connection with the upstream check valve assembly 13.

The relief valve assembly 16 is best shown in FIGS. 5 and 6 and it includes a stationary housing 67 and a valve member 68 in the housing movable toward and away from a stationary annular seat 69. The resilient disk 71 is carried on the valve member for contact with the annular seat 69. The valve member 68 includes a valve stem 72 slidably mounted in the guide 73 and having the circular plate 74 fixed on one end by means of the threaded stem element 75 and washer 75*a*. The cover 76 is bolted to the housing 67 and clamps the rim of a relatively large rolling diaphragm 77 between them. The relatively small rolling diaphragm 78 has its outer periphery clamped between the guide 73 and a wall of the housing 67. The inner portion of the rolling diaphragm 78 is fixed to the valve member 68 by means of the clamping plate 79 and threaded fastenings 81. The effect of the diaphragm 78 is to offset the unbalanced forces resulting from the pressure differential between zone 15 and atmospheric pressure in discharge 104. A chamber 82 is formed within the housing 67 and between the flexible diaphragms 77 and 78, and this chamber 82 communicates with a terminal fitting 83. A similar terminal fitting 84 is carried on the cover 76 and communicates with the chamber 85 between the cover 76 and the flexible diaphragm 77.

The coil compression spring 86 has one end seated on the stationary guide member 73 and the other end contacts the pressure plate 87 mounted for self-aligning movement on the spherical surface of the central boss 88 on the plate 74. The tubular flanged part 89 is bolted to the housing 67 at 91 and is bolted to the mating flanged part 92 on the body 19, as shown in FIG. 1.

From this description it will be understood that pressure in the chamber 85 acts to close the valve disk 71 against the stationary seat 69, in opposition to the force of the spring 86. Pressure in the chamber 82 serves to supplement the force of the spring 86. Movement of the valve member 68 is guided by the sliding contact between the stem 72 and the guide 73 and by the sliding of the fingers 93 in the axial bore 94 of the member having the stationary seat 69. The guide fingers 93 are formed integrally with the circular plate 95 which holds the resilient disk 71 in place on the valve member 68.

Means are provided for subjecting the relief valve chamber 85 to pressure in the inlet passage 17 and, as shown in the drawings, this means includes the velocity sensitive pressure pickup tube 96 extending through the body 19 and connected to the terminal fitting 97. A pipe 98 connects the terminal fitting 97 to the terminal fitting 84 of the relief valve assembly 16. Additional means are provided for connecting the aspirated second chamber 53 in the upstream check valve assembly 13 to the space 82 in the relief valve housing 67 between the flexible diaphragms 77 and 78. A shown in the drawings, this means includes the terminal fitting 99 which communicates with the chamber 53, and the terminal fitting 83 which communicates with the relief valve space 82. A pipe 101 connects the terminal fitting 9 to the terminal fitting 83, as shown in FIG. 1. Conventional test fittings 102 and 103 are provided on the body 19 in communication with the inlet passage 17 and the outlet passage 18. These test fittings are normally closed.

In the operation of the backflow prevention device, the pressure of water in the upstream gate valve 11 acts through the inlet passage 17 and against the exposed portion of the upstream check valve assembly 13 within the annular stationary seat 25. This pressure tends to open the valve in opposition to the force of the spring 33. When the upstream pressure has reached a sufficient intensity to move the valve disk 29 away from the seat 25, the pressure acts over a larger cross sectional area of the valve poppet 28 and the additional force increases the opening movement of the valve disk 29 away from the stationary seat 25. Water flows into the arcuate space or first chamber 46 between the shoulders 47 and 48 and passes through the ejector nozzle 44 and into the flared entrance opening 50 of the transverse passage 51. The rapid flow from the small discharge end of the ejector nozzle 44 reduces the pressure of liquid in the chamber 53 by an aspiration effect. Water is discharged from the transverse passage 51 through the third chamber or zone 15 and its velocity head acts directly on the exposed surface of the valve poppet 64 in the downstream check valve assembly 14. Water is discharged through the window 60 in the wall of the barrel 61 and passes into the discharge passage 18 in the body 19.

The configuration of the ribs and spaces on the outer surface of the valve poppet 28 in the upstream check valve assembly 13 has the following beneficial effect: The flow from the inlet passage 17 is shielded from any substantial communication directly with the zone 15, and instead the flow from the inlet passage 17 is directed toward the arcuate space or first chamber 46 which is defined between the inclined ribs 47 and 48 and which space 46 feeds the ejector nozzle 44. The spaces or pockets 55 and 56 on the other side of these barrel-contacting ribs 47 and 48 are in direct open communication with the side window 26 in the stationary barrel 21, and hence are in communication with the third chamber or zone 15. The circumferential cross flow on the periphery of the valve poppet 28 through the groove 54, pockets 55 and 56 and side window 26 serves as a barrier to leakage from the inlet 17 axially along the cylindrical surface of the valve poppet 28 into the aspirated second chamber 53.

Check valve 13 is designed to maintain a specified minimum pressure differential and cooperates with the relief valve assembly 16 to insure that no reverse flow could ever occur. If for any reason the pressure differential reflected to the assembly falls below a prescribed level, the relief valve assembly opens to vent the zone 15 to atmosphere as a means of maintaining this required differential. The second check valve 14 normally also maintains a lesser pressure differential; however, it is subject to system pressure conditions wherein the pressure in discharge chamber 18 can exceed the normal supply pressure in chamber 17. Under these conditions

the function of check valve **14** is to remain closed and isolate zone **15** from the higher backflow pressures. If the second check valve **14** should leak, this reverse flow would tend to equalize the pressure differential maintained across the first check valve **13** and consequently the relief valve assembly **16** would be caused to open and vent the zone **15** to atmosphere and dissipate the reverse flow leakage.

More particularly, if the differential pressure between the chamber **85** and the chamber **82** is not maintained, the spring **86** acts in a direction to open the valve by moving the disk **71** away from the stationary seat **69**. This pressure differential could be reduced by reason of leakage through the downstream check valve **14**, or it might be reduced by failure to maintain the pressure drop through the upstream check valve **13**. Any factor or foreign matter which could cause leakage through the upstream check valve **13** would tend to diminish the pressure differential between the chambers **82** and **85**.

Check valve **13** functions to maintain a high initial pressure differential as a backflow protection margin of safety, and to resist initial flow through the check valve. However, as normal flow is established and increases, the initial pressure differential across its seat is reflected against the larger area of the valve poppet **28** and is applied across the ejector **44** which in turn aspirates the chamber **53**. This combined effect causes the check valve **13** to provide a substantially reduced pressure differential under flowing conditions. This substantially reduced pressure differential is actually less than the initial pressure differential required under a no flow condition. In order to prevent this lower than normal pressure differential from causing the differential relief valve to open, a higher pressure differential is reflected to the relief valve assembly **16** as a result of adding the velocity head pressure sensed through tube **96** to pressure chamber **85** and by also applying the reduced pressure in the aspirated chamber **53** to pressure chamber **82**. The result is that the differential reflected to the control is greater than the differential between pressure chamber **17** and zone **15** but it is only greater under velocity flowing conditions. Under static or reverse flow conditions wherein the relief valve assembly may be required to open, unwanted pressure differentials related to normal flow conditions are not induced.

The device shown in the drawings and described above has been found to have exceptional operating characteristics. The pressure required for initial opening of the upstream check valve **13** is relatively high, and yet the pressure drop from the inlet passage **17** to the outlet passage **18** is exceptionally low during normal flow conditions.

Having fully described my invention, it is to be understood that I am not to be limited to the details herein set forth but that my invention is of the full scope of the appended claims.

I claim:

1. In a backflow prevention apparatus for installation between a supply pipe and a discharge pipe, the apparatus including upstream and downstream check valve assemblies with a zone between them, and a relief valve device for venting the zone to atmosphere under predetermined pressure conditions in the pipes, the improvement comprising, in combination: an inlet passage from the supply pipe terminating in a stationary valve seat forming a part of the upstream check valve assembly, a stationary barrel positioned coaxially of said valve seat, a valve poppet guided for movement in said barrel toward and away from said valve seat, a spring acting to move said valve poppet into sealing contact with said valve seat, said spring acting to create a pressure drop through the upstream check valve assembly when said valve poppet is initially moved away from said seat by fluid pressure in said inlet passage, means cooperating with said barrel and said valve poppet to define a chamber remote from said valve seat, an ejector nozzle on said valve poppet receiving fluid from said barrel when said valve poppet has separated from said valve seat, said ejector nozzle having a discharge end communicating with said chamber so that relatively rapid fluid flow from said ejector nozzle causes a reduction in fluid pressure in said chamber to oppose the action of said spring and thereby reduce the pressure drop across the upstream check valve assembly, the downstream check valve assembly having a valve poppet communicating with the zone and positioned to receive the velocity head discharge from the upstream check valve assembly.

2. In backflow prevention apparatus for installation between a supply pipe and a discharge pipe, the apparatus including upstream and downstream check valve assemblies with a zone between them, and a relief valve device for venting the zone to atmosphere under predetermined pressure conditions in the pipes, the improvement comprising, in combination: an inlet passage from the supply pipe terminating in a stationary valve seat forming a part of the upstream check valve assembly, a stationary barrel positioned coaxially of said valve seat, a valve poppet guided for movement in said barrel toward and away from said valve seat, a spring acting to move said valve poppet into sealing contact with said valve seat, said spring acting to create a pressure drop through the upstream check valve assembly when said valve poppet is initially moved away from said seat by fluid pressure in said inlet passage, means cooperating with said barrel and said valve poppet to define a spring chamber remote from said valve seat and enclosing said spring, an ejector nozzle on said valve poppet receiving fluid from said barrel when said valve poppet has separated from said valve seat, said ejector nozzle having a discharge end communicating with said spring chamber so that relatively rapid fluid flow from said ejector nozzle causes a reduction in fluid pressure in said spring chamber to oppose the action of said spring and thereby reduce the pressure drop across the upstream check valve assembly.

3. In backflow prevention apparatus for installation between a supply pipe and a discharge pipe, the apparatus including upstream and downstream check valve assemblies with a zone between them, and a relief valve device for venting the zone to atmosphere under predetermined pressure conditions in the pipes, the improvement comprising, in combination: an inlet passage from the supply pipe terminating in a stationary annular valve seat forming a part of the upstream check valve assembly, a stationary barrel positioned coaxially of said valve seat, a valve poppet guided for movement in said barrel toward and away from said valve seat, a spring acting to move said valve poppet into sealing contact with said valve seat, said spring acting to create a pressure drop through the upstream check valve assembly when said valve poppet is initially moved away from said seat by fluid pressure in said inlet passage, means cooperating with said barrel and said valve poppet to define a chamber remote from said valve seat, aspirator means receiving fluid from said barrel when said valve

poppet has separated from said valve seat, said aspirator means acting to reduce the pressure in said chamber to oppose the action of said spring and thereby reduce the pressure drop across the upstream check valve assembly, said relief valve device having a valve subjected to differential pressure between the pressure in the inlet passage and the pressure in said chamber of the upstream check valve assembly.

4. In backflow prevention apparatus for installation between a supply pipe and a discharge pipe, the apparatus including upstream and downstream check valve assemblies with a zone between them, and a relief valve device for venting the zone to atmosphere under predetermined pressure conditions in the pipes, the improvement comprising, in combination: an inlet passage from the supply pipe terminating in a stationary annular valve seat forming a part of the upstream check valve assembly, a stationary barrel positioned coaxially of said valve seat, a valve poppet guided for movement in said barrel toward and away from said valve seat, a spring acting to move said valve poppet into sealing contact with said valve seat, said spring acting to create a pressure drop through the upstream check valve assembly when said valve poppet is initially moved away from said seat by fluid pressure in said inlet passage, means cooperating with said barrel and said valve poppet to define a chamber remote from said valve seat, an ejector nozzle on said valve poppet receiving fluid from said barrel when said valve poppet has separated from said valve seat, said ejector nozzle having a discharge end communicating with said chamber so that relatively rapid fluid flow from said ejector causes a reduction in fluid pressure in said chamber to oppose the action of said spring and thereby reduce the pressure drop across the upstream check valve assembly, said relief valve device having a valve subjected to differential pressure between the pressure in the inlet passage and the pressure in said chamber of the upstream check valve assembly.

5. In backflow prevention apparatus for installation between a supply pipe and a discharge pipe, the apparatus including upstream and downstream check valve assemblies with a zone between them, and a relief valve device for venting the zone to atmosphere under predetermined pressure conditions in the pipes, the improvement comprising, in combination: an inlet passage from the supply pipe terminating in a stationary valve seat forming a part of the upstream check valve assembly, a stationary barrel positioned coaxially of said valve seat, a valve poppet guided for movement in said barrel toward and away from said valve seat, a spring acting to move said valve poppet into sealing contact with said valve seat, said spring acting to create a pressure drop through the upstream check valve assembly when said valve poppet is initially moved away from said seat by fluid pressure in said inlet passage, means cooperating with said barrel and said valve poppet to define a spring chamber remote from said valve seat and enclosing said spring, an ejector nozzle on said valve poppet receiving fluid from said barrel when said valve poppet has separated from said valve seat, said ejector nozzle having a discharge end communicating with said spring chamber so that relatively rapid fluid flow from said ejector nozzle causes a reduction in fluid pressure in said spring chamber to oppose the action of said spring and thereby reduce the pressure drop across the upstream check valve assembly, the downstream check valve assembly having a valve poppet communicating with the zone and positioned to receive the velocity head discharge from the upstream check valve assembly, said relief valve device having a valve subjected to differential pressure between the pressure in the inlet passage and the pressure in said chamber of the upstream check valve assembly.

6. In backflow prevention apparatus for installation between a supply pipe and a discharge pipe, the apparatus including upstream and downstream check valve assemblies with a zone between them, and a relief valve device for venting the zone to atmosphere under predetermined pressure conditions in the pipes, the improvement comprising, in combination: an inlet passage from the supply pipe terminating in a stationary valve seat forming a part of the upstream check valve assembly, a stationary barrel positioned coaxially of said valve seat, a valve poppet guided for movement in said barrel toward and away from said valve seat, a spring acting to move said valve poppet into sealing contact with said valve seat, said spring acting to create a pressure drop through the upstream check valve assembly when said valve poppet is initially moved away from said seat by fluid pressure in said inlet passage, means cooperating with said barrel and said valve poppet to define a chamber remote from said valve seat, an ejector nozzle on said valve poppet receiving fluid from said barrel when said valve poppet has separated from said valve seat, the outer surface of the valve poppet cooperating with said barrel to form two series of pockets and ribs symmetrical with respect to said ejector nozzle and acting to minimize flow from said seat into said chamber, said ejector nozzle having a discharge end communicating with said chamber so that relatively rapid fluid flow from said ejector nozzle causes a reduction in fluid pressure in said chamber to oppose the action of said spring and thereby reduce the pressure drop across the upstream check valve assembly.

7. In backflow prevention apparatus for installation between a supply pipe and a discharge pipe, the apparatus including upstream and downstream check valve assemblies with a zone between them, and a relief valve device for venting the zone to atmosphere under predetermined pressure conditions in the pipes, the improvement comprising, in combination: an inlet passage from the supply pipe terminating in a stationary valve seat forming a part of the upstream check valve assembly, a stationary barrel positioned coaxially of said valve seat, a valve poppet guided for movement in said barrel toward and away from said valve seat, a spring acting to move said valve poppet into sealing contact with said valve seat, said spring acting to create a pressure drop through the upstream check valve assembly when said valve poppet is initially moved away from said seat by fluid pressure in said inlet passage, means cooperating with said barrel and said valve poppet to define a chamber remote from said valve seat, an ejector nozzle on said valve poppet receiving fluid from said barrel when said valve poppet has separated from said valve seat, the outer surface of the valve poppet cooperating with said barrel to form pockets and ribs to produce circumferential flow of fluid on the outer surface of said valve poppet away from said ejector nozzle and thereby acting to minimize axial flow from said seat along said valve poppet into said chamber, said ejector nozzle having a discharge end communicating with said chamber so that relatively rapid fluid flow from said ejector nozzle causes a reduction in fluid pressure in said chamber to oppose the action of said spring and thereby reduce the

pressure drop across the upstream check valve assembly.

8. In backflow prevention apparatus for installation between a supply pipe and a discharge pipe, the apparatus including upstream and downstream check valve assemblies with a zone between them, and a relief valve device for venting the zone to atmosphere under predetermined pressure conditions in the pipes, the improvement comprising, in combination: an inlet passage from the supply pipe terminating in a stationary valve seat forming a part of the upstream check valve assembly, a body, a stationary barrel positioned within the body coaxially of said valve seat, said body having a removable cover, a valve poppet guided for movement in said barrel toward and away from said valve seat, a spring acting to move said valve poppet into sealing contact with said valve seat, means cooperating with said barrel and said cover and said valve poppet to define a spring chamber remote from said valve seat and enclosing said spring, said valve poppet having a central axial stem fixed thereto, a spring retainer positioned within a portion of said spring and having a central opening for sliding contact with said stem, said valve poppet, stem, spring and retainer being axially insertable into said barrel as a unitary assembly in the absence of said cover, an ejector nozzle on said valve poppet receiving fluid from said barrel when said valve poppet has separated from said valve seat, said ejector nozzle having a discharge end communicating with said spring chamber so that relatively rapid fluid flow from said ejector nozzle causes a reduction in fluid pressure in said spring chamber to oppose the action of said spring and thereby reduce the pressure drop across the upstream check valve assembly.

9. In backflow prevention apparatus for installation between a supply pipe and a discharge pipe, the apparatus including upstream and downstream check valve assemblies with a zone between them, and a relief valve device for venting the zone to atmosphere under predetermined pressure conditions in the pipes, the improvement comprising, in combination: an inlet passage from the supply pipe terminating in a stationary valve seat forming a part of the upstream check valve assembly, a valve poppet guided for movement toward and away from said valve seat, a first spring acting to move said valve poppet into sealing contact with said valve seat, said first spring acting to create a pressure drop through the upstream check valve assembly when said valve poppet is initially moved away from said seat by fluid pressure in said inlet passage, means cooperating with said valve poppet to define a chamber remote from said valve seat, aspirator means on said valve poppet receiving fluid when said valve poppet has separated from said valve seat, and acting to cause a reduction in fluid pressure in said chamber to oppose the action of said first spring and thereby reduce the pressure drop across the upstream check valve assembly, said relief valve device having relatively movable valve parts for controlling flow from said zone to atmosphere, a second spring acting to cause relative movement of said valve parts toward open position, and differential pressure means sensitive to pressure in said inlet passage and in said aspirated chamber for changing the effective force of said second spring.

10. The combination set forth in claim 9 in which said relief valve device has a first expansible space sensitive to pressure in said inlet passage and has a second expansible space sensitive to pressure in said aspirated chamber, said spaces sharing a common movable wall.

11. In backflow prevention apparatus for installation between a supply pipe and a discharge pipe, the apparatus including upstream and downwstream check valve assemblies with a zone between them, and a relief valve device for venting the zone to atmosphere under predetermined pressure conditions in the pipes, the improvement comprising, in combination: an inlet passage from the supply pipe terminating in a stationary valve seat forming a part of the upstream check valve assembly, a valve poppet guided for movement toward and away from said valve seat, a first spring acting to move said valve poppet into sealing contact with said valve seat, said first spring acting to create a pressure drop through the upstream check valve assembly when said valve poppet is initially moved away from said seat by fluid pressure in said inlet passage, means cooperating with said valve poppet to define a chamber remote from said valve seat, aspirator means on said valve poppet receiving fluid when said valve poppet has separated from said valve seat, and acting to cause a reduction in fluid pressure in said chamber to oppose the action of said first spring and thereby reduce the pressure drop across the upstream check valve assembly, said relief valve device having a movable valve element cooperating with a stationary seat for controlling flow to atmosphere from said zone, a second spring acting to cause said movable valve element to move toward open position, and differential pressure means sensitive to pressure in said inlet passage and in said aspirated chamber for changing the effective force of said second spring.

12. In backflow prevention apparatus for installation between the supply pipe and the discharge pipe, the apparatus including upstream and downstream check valve assemblies with a zone between them, and a relief device for venting the zone to atmopshere under predetermined pressure conditions in the pipe, the improvement comprising, in combination: an inlet passage from the supply pipe leading to the upstream check valve assembly, said upstream check valve assembly having a chamber aspirated by fluid flow through said upstream check valve assembly, said relief valve device having a movable valve element cooperating with a stationary seat for controlling flow from said zone to atmosphere, said movable valve element including a stem, a body enclosing said stem and having a cover, a plate having a spherical hub portion fixed to said stem, a first flexible diaphragm engaging said plate and having an outer periphery clamped between the cover and the body to form a first expansible space, a second flexible diaphragm extending between the stem and the body, a self-aligned member mounted on said spherical hub portion of said plate, a spring operatively positioned between said member and said body and acting to move said movable valve element away from said stationary seat, means for connecting said first expansible space to said inlet passage, and means for connecting the space within the body and between said diaphragms to said aspirated chamber.

13. In backflow prevention apparatus for installation between the supply pipe and the discharge pipe, the apparatus including upstream and downstream check valve assemblies with a zone between them, and a relief valve device for venting the zone to atmosphere under predetermined pressure conditions in the pipe, the improvement comprising, in combination: an inlet passage from the supply pipe leading to the upstream check

valve assembly, said upstream check valve assembly having a chamber aspirated by fluid flow through said upstream check valve assembly, said relief valve device having a movable valve element cooperating with a stationary seat for controlling flow from said zone to atmosphere, said movable valve element including a stem, a body enclosing said stem and having a cover, a first flexible diaphragm having an outer periphery clamped between the cover and the body to form a first expansible space, a second flexible diaphragm extending between the stem and the body, a spring operatively positioned between said stem and said body and acting to move said movable valve element away from said stationary seat, means for guiding said stem for movement within said body, said means including a guide member within said spring fixed relative to said body and having sliding contact with said stem, said guide means also including fingers carried by said movable valve element and slidably engaging a stationary bore upstream of said stationary seat, means for connecting said first expansible space to said inlet passage, and means for connecting the space between said diaphragms to said aspirated chamber.

14. In backflow prevention apparatus for installation between a supply pipe and a discharge pipe, the apparatus including upstream and downstream check valve assemblies with a zone between them, and a relief valve device for venting the zone to atmosphere under predetermined pressure conditions in the pipes, the improvement comprising, in combination: an inlet passage from the supply pipe terminating in a stationary valve seat forming a part of the upstream check valve assembly, a stationary barrel positioned coaxially of said valve seat, a valve poppet guided for movement in said barrel toward and away from said valve seat, a spring acting to move said valve poppet into sealing contact with said valve seat, said spring acting to create a pressure drop through the upstream check valve assembly when said valve poppet is initially moved away from said seat by fluid pressure in said inlet passage, means cooperating with said barrel and said valve poppet to define three chambers, the first chamber being formed between said valve seat and one side of said valve poppet, the second chamber being formed on the other side of said valve poppet and in cooperation with said stationary barrel, the third chamber being formed downstream of said valve poppet and said barrel, aspirator means receiving fluid from said first chamber when said valve poppet has separated from said valve seat, said aspirator means acting to reduce the pressure in said second chamber to oppose the action of said spring and thereby reduce the pressure drop across the upstream check valve assembly, said relief valve device having a valve subjected to differential pressure between the pressure in the inlet passage and the pressure in said second chamber.

15. In backflow prevention apparatus for installation between a supply pipe and a discharge pipe, the apparatus including upstream and downstream check valve assemblies with a zone between them, and a relief valve device for venting the zone to atmosphere under predetermined pressure conditions in the pipes, the improvement comprising, in combination: an inlet passage from the supply pipe terminating in a stationary valve seat forming a part of the upstream check valve assembly, a stationary barrel positioned coaxially of said valve seat, a valve poppet guided for movement in said barrel toward and away from said valve seat, a spring acting to move said valve poppet into sealing contact with said valve seat, said spring acting to create a pressure drop through the upstream check valve assembly when said valve poppet is initially moved away from said seat by fluid pressure in said inlet passage, means cooperating with said barrel and said valve poppet to define three chambers, the first chamber being formed between said valve seat and one side of said valve poppet, the second chamber being formed on the other side of said valve poppet and in cooperation with said stationary barrel, the third chamber being formed downstream of said valve poppet and said barrel, an ejector nozzle having an intake receiving flow from the first chamber when said valve poppet is separated from said valve seat, a discharge passage from said ejector nozzle communicating with said third chamber, and a space between its intake and its discharge passage connected to said second chamber so that relatively rapid flow from said ejector nozzle causes the reduction in pressure in said second chamber to oppose the action of said spring and thereby reduce the pressure drop across the check valve assembly.

16. The combination set forth in claim **15** in which the downstream check valve assembly has a valve poppet communicating with the thrid chamber and positioned to receive the velocity head discharge from the upstream check valve assembly.

17. The combination set forth in claim **15** in which said ejector nozzle is mounted on said valve poppet.

* * * * *

United States Patent [19]

Lourdeaux

[11] **4,276,905**

[45] **Jul. 7, 1981**

[54] **MECHANISM INCLUDING TWO CUT-OFF DEVICES IN SERIES**

[75] Inventor: **Bernard Lourdeaux**, Ismier, France

[73] Assignee: Neyrpic, Grenoble, France

[21] Appl. No.: **128,562**

[22] Filed: **Mar. 10, 1980**

[30] **Foreign Application Priority Data**

Mar. 13, 1979 [FR] France 79 06321

[51] **Int. Cl.**[3] **F16K 5/00; F03B 1/00**

[52] **U.S. Cl.** **137/613**; 415/151

[58] **Field of Search** 137/613, 614, 149.2; 415/151

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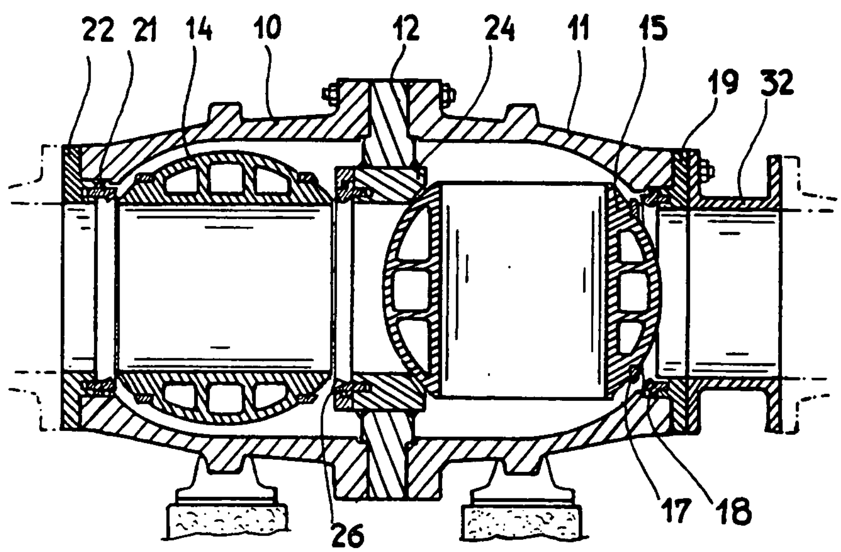
Primary Examiner—Martin P. Schwadron
Assistant Examiner—A. Michael Chambers
Attorney, Agent, or Firm—Haseltine and Lake

[57] **ABSTRACT**

A mechanism for a hydraulic pipe comprises two rotatable cut-off devices in series arranged inside two half-shells which are arranged symmetrically, relative to a mean transverse plane, and which are connected by being bolted together by their flanges. Each half-shell supports the journals of a cut-off device and an intermediate piece may be provided for supporting center gaskets.

The mechanism is particularly applicable to the protection of turbines in a high-fall hydroelectric installation.

1 Claim, 3 Drawing Figures



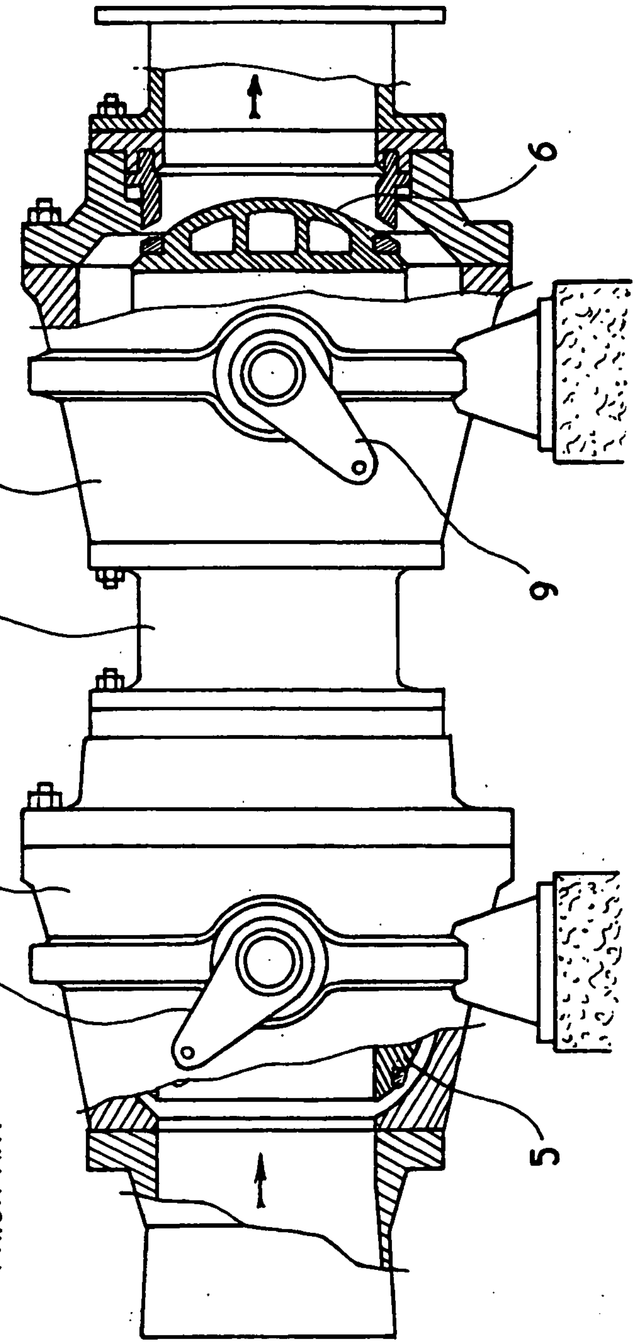


Fig 1
PRIOR ART

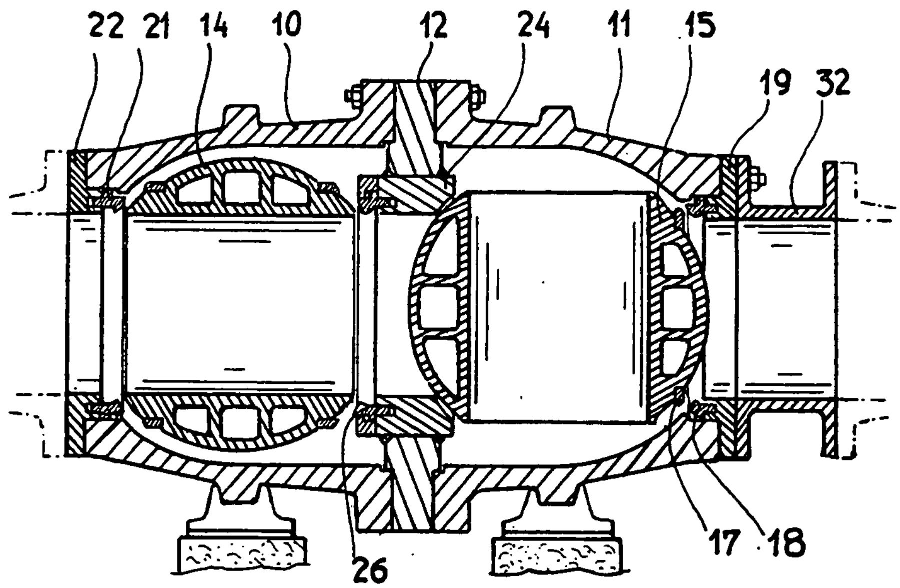


Fig 2

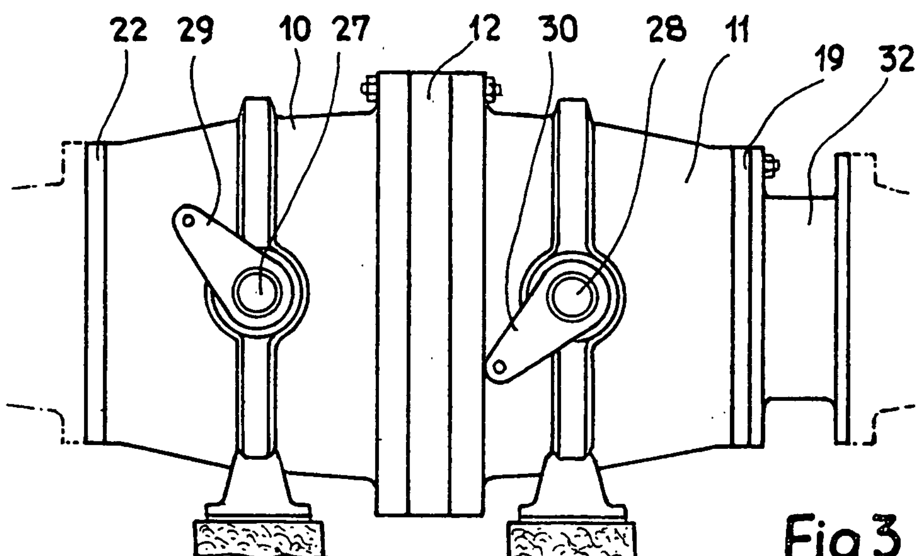


Fig 3

MECHANISM INCLUDING TWO CUT-OFF DEVICES IN SERIES

The present invention relates to a mechanism including two cut-off devices in series, particularly but not exclusively for a high-fall hydro-electric installation using turbines.

In installations of this type, including turbines having fixed guide-rings, or turbine pumps, two cut-off valves are arranged in series, as a security measure, in order to protect the hydraulic machinery. The downstream one of the valves ensures the normal opening and closing operations. The upstream one of the valves constitutes a safety device for emergency shut-off if there is an accident involving the downstream valve or the downstream pipe; shut-off in the latter case is referred to as "open sluice" shut-off.

Hitherto, this has been achieved using two valves mounted in series on the same pipe, each valve of course being equipped with hydraulic control jacks. FIG. 1 of the drawings is a simplified representation of the valves of an installation of this type, which successively comprise an upstream valve 1 having a cut-off device 5, an intermediate disconnecting sleeve 2 and a downstream valve 3 having a cut-off device 6. The control mechanisms of the two cut-off devices 5 and 6, which could be jacks anchored in the concrete of the passageway and having rods which are articulated at the end of control levers 8 and 9 respectively of the devices 5, 6 have not been shown in the Figure in order to simplify the drawing. The control mechanisms could alternatively comprise jacks which are each fixed directly to the shell of the valve in question, as described, for example, in French Pat. No. 1,363,146.

This arrangement has the disadvantage of constituting a longer piece of equipment of virtually twice the bulk of a single valve. It therefore represents a heavy and expensive installation which also requires a passageway of greater dimensions for the purpose of inspections and maintenance.

It is an object of the invention to reduce the bulk and weight of such equipment and applies to a mechanism, with two cut-off devices in series, for a high-fall hydraulic pipe, which mechanism comprises an upstream cut-off device and a downstream cut-off device, both of which can rotate on journals.

According to the invention, there is provided a mechanism for a hydraulic pipe comprising:

an upstream cut-off device;

a downstream cut-off device;

journals for supporting said cut-off devices in rotation; and

a shell adapted for connection to the hydraulic pipe upstream and downstream thereof and comprising an upstream half-shell and a downstream half-shell, said shells being arranged symmetrically, relative to a mean transverse plane, and connected to one another by being bolted onto flanges thereof;

said cut-off devices being arranged in series in said shell with the respective journals thereof supported by said respective half-shells thereof.

According to a preferred embodiment of the invention, the mechanism comprises a generally planar intermediate piece arranged between said two cut-off devices, and which extends between said flanges for joining said upstream half-shell and said downstream half-

shell, and at least one gasket for at least one of said cut-off devices provided on said intermediate piece.

An embodiment according to the invention will now be described by way of example only, with reference to FIGS. 2 and 3 of the drawings.

In the drawings:

FIG. 2 is an axial section through an embodiment of mechanism according to the invention, perpendicular to the axes of rotation of the cut-off devices; and

FIG. 3 is a side view of the mechanism of FIG. 2.

Referring to FIGS. 2 and 3, the double valve mechanism comprises two cut-off devices 14, 15 housed within a shell which mainly comprises two symmetrical half-shells 10 and 11, which are joined by being bolted together by their flanges, a generally planar intermediate piece 12 extending between the flanges of the half-shells. Advantageously, the upstream and downstream half-shells 10 and 11 each consist of the upstream element of the shell of a single valve as shown in FIG. 1.

In the embodiment of FIGS. 2 and 3, the double valve comprises two seals for the upstream spherical cut-off device 14, which is shown in the open position, and a single seal for the downstream spherical cut-off device 15, which is shown in the closed position but without application of the gaskets. In known manner, for the downstream seal of the downstream cut-off device 15, a fixed seat or gasket 17 carried by the downstream cut-off device 15 is conjugated, in the closed position of the cut-off device 15, with a movable gasket 18, mounted in a gasket-carrying ring 19. The hydraulic system for causing the movable gasket 18 to bear on the fixed seat or gasket 17 is not shown because it is well known in this type of valve. A completely analogous mechanism is used for the upstream seat or gasket of the upstream cut-off device 14, a movable gasket 21 being mounted in a gasket-carrying ring 22 for bearing against the seat or gasket of the cut-off device 14 in its closed position.

A movable downstream gasket 26 for bearing against a seat or gasket of the upstream cut-off device 14 is mounted in a ring 24 welded to and forming part of the intermediate piece 12, and in this case again, the hydraulic system for displacing the movable gasket 26 has not been shown.

The cut-off devices 14 and 15 are each provided with journals 27 and 28, and operating levers 29 and 30, for coupling to a known control jack, are provided on the outside of the shell.

It is seen that, compared with the known arrangement shown in FIG. 1, the bulk of an intermediate sleeve and of a downstream shell has been eliminated, this corresponding to a total reduction in bulk of about one pipe diameter. A reduction in weight, which can reach 20%, can thus be achieved, whilst at the same time retaining the same degree of safety and even improving it to a certain extent by virtue of the greater rigidity of the gasket-carrying intermediate piece, which reduces the risks of deformation of the gasket bearings.

Of course, the invention is not intended to be strictly limited to the embodiment which has been described by way of example only. On the contrary, it also includes embodiments which only differ therefrom in details, in different methods of operation of in the use of equivalent means. Thus, an upstream gasket for the downstream cut-off device 15 could also be mounted on the ring 24. Conversely, if the particular conditions allowed, it would also be possible to envisage retaining

only the end gaskets, and to simplify, or even dispense with, the intermediate piece between the two shells **10** and **11**.

What is claimed is:

1. A tandem hydraulic valve assembly for use in high pressure and high flow environments such as a high-fall hydroelectric installation, the valve comprising:

a main valve shell, including an upstream shell half and a downstream shell half symmetrically disposed on opposite sides of a transverse medial plane, the respective shell halves having radial flanges at the mutually presented juxtaposed ends thereof;

bolts extending through said flanges and immovably securing the respective shell halves to each other;

a rotatable valve member and an adjacent cooperating valve seat therefor positioned within said upstream shell half;

a rotatable valve member and an adjacent cooperating valve seat therefor positioned within said downstream shell half; and

a journal for each rotatable valve member, the respective journals being supported in their associated shell half for independent rotary movement, and a generally planar plate interposed between said mutually presented juxtaposed ends of the respective shell members and their associated flanges, said bolts extending through said plate and said flanges and immovably securing said plate and said shell halves to each other, and at least one of said adjacent valve seats carried by said plate and cooperating with an adjacent one of said valve members.

* * * * *

United States Patent [19]

Becker et al.

[11] **4,284,097**

[45] **Aug. 18, 1981**

[54] **IN LINE BACK FLOW PREVENTER**

[75] Inventors: **Bernard B. Becker**, Belmont; **John K. Bowman**, Brighton; **Cyril A. Randall**, Belmont, all of Mass.

[73] Assignee: **Amtrol Inc.**, West Warwick, R.I.

[21] Appl. No.: **58,566**

[22] Filed: **Jul. 18, 1979**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 890,964, Mar. 28, 1978, Pat. No. 4,232,704.

[51] **Int. Cl.**^{3} **F16K 15/06; F16K 45/00**

[52] **U.S. Cl.** **137/218**; 137/512; 137/541; 137/454.2

[58] **Field of Search** 137/215, 217, 218, 116, 137/512, 512.3, 541, 362, 454.2, 454.4; 85/8.8

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Primary Examiner—William R. Cline
Attorney, Agent, or Firm—Fisher, Christen & Sabol

[57] **ABSTRACT**

A back flow preventing device is disclosed which prevents the reverse flow of water from a point of use into a water supply system. The device has a casing with coaxially aligned inlet and outlet openings, and containing coaxially aligned inlet and outlet check valves. The coaxial alignment of the inlet and outlet openings, and of the inlet and outlet check valves serves to minimize the pressure drop through the device. Between the inlet and outlet check valves is a diaphragm actuated relief valve which opens to drain the passage between the check valves if they should malfunction or if there is a drop in the supply line pressure sufficient to cause actual or potential reverse flow back toward the supply line. The internally-located inlet and outlet check valves are each removably secured in place by internally-located retaining rings.

12 Claims, 6 Drawing Figures

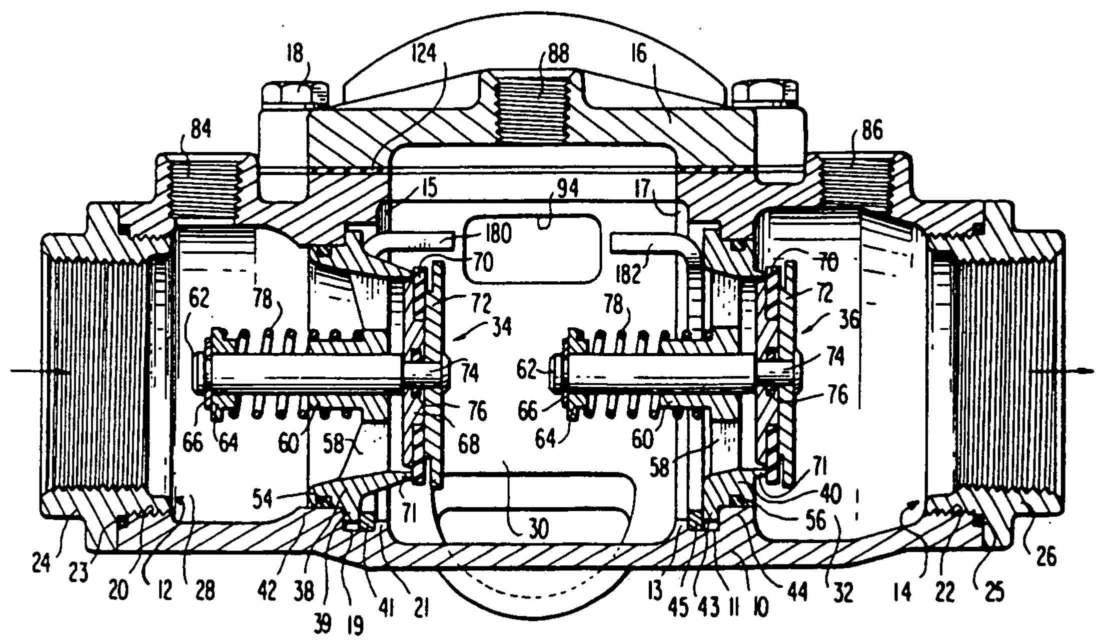

FIG. 1

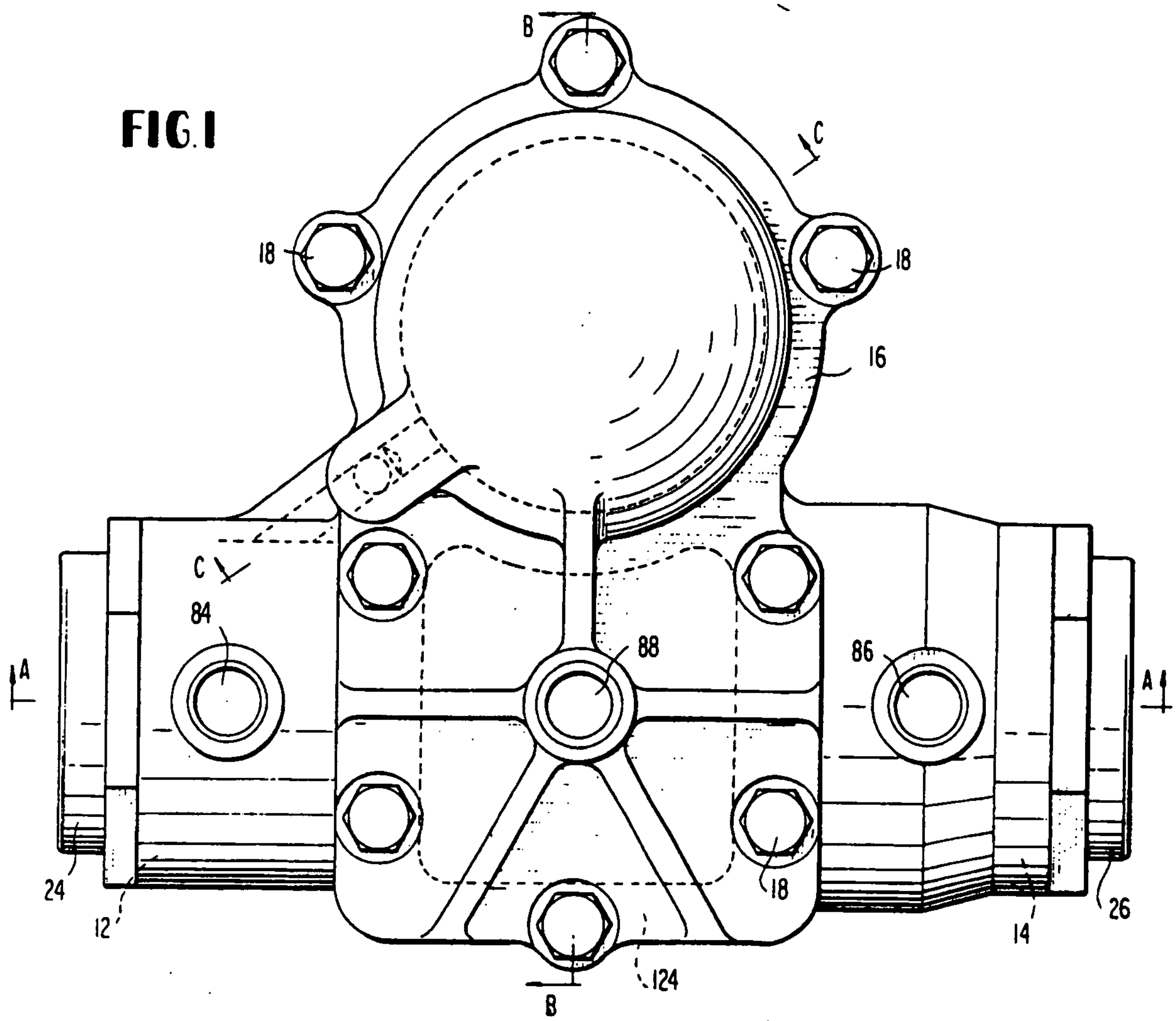
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FIG. 2

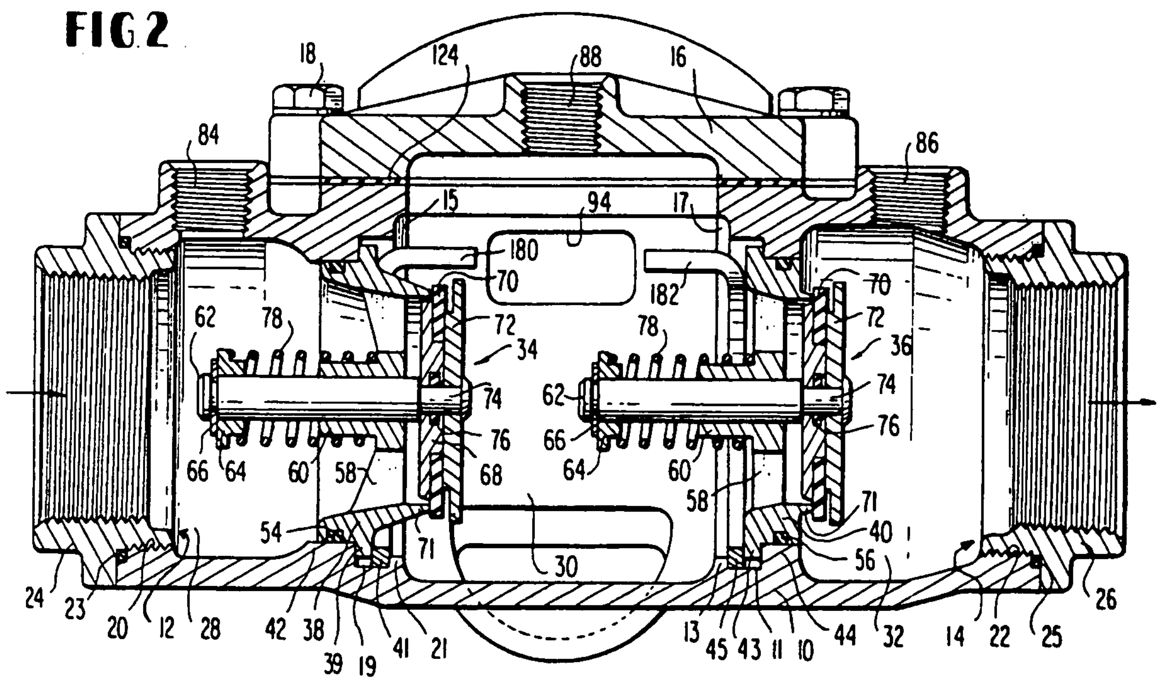
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FIG 3

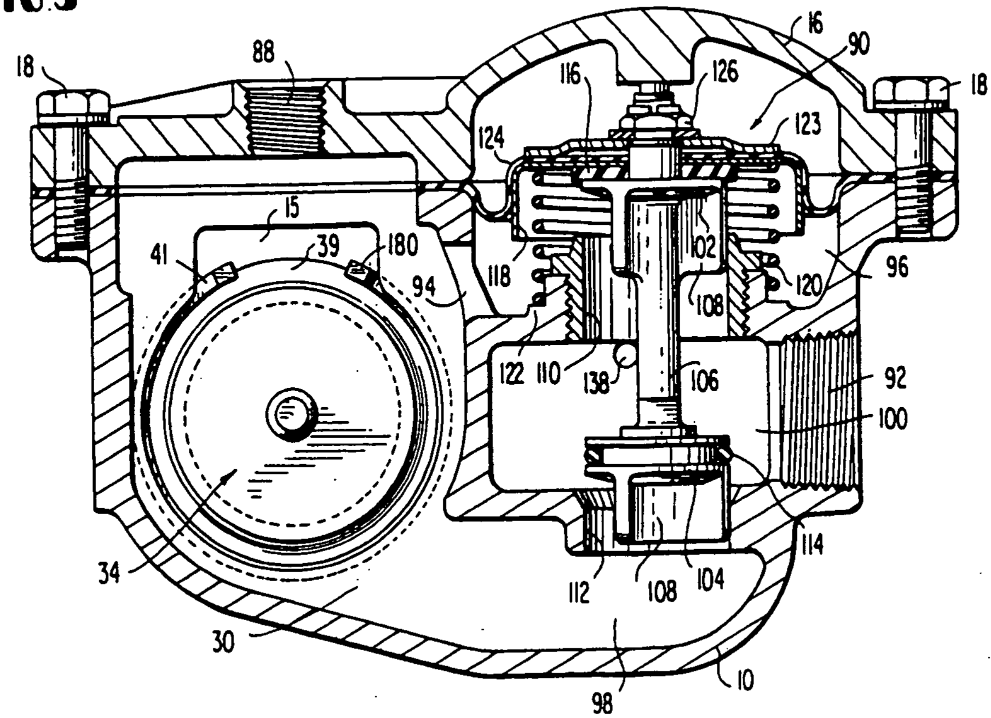
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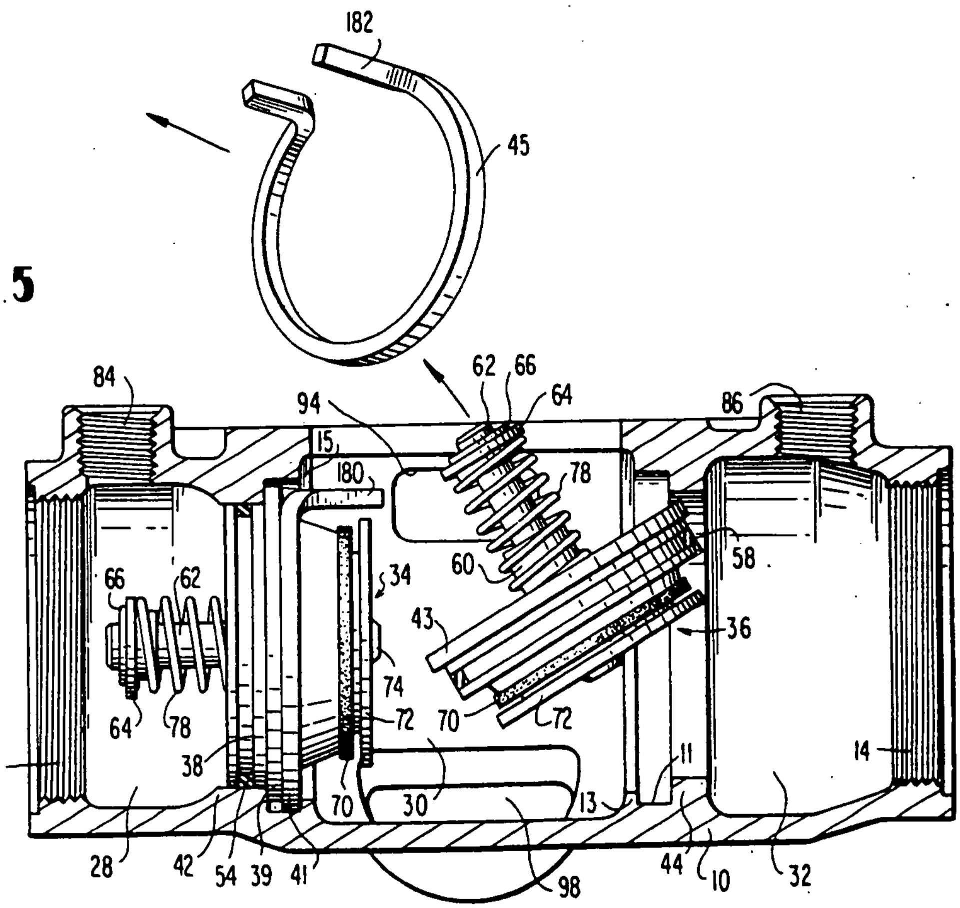
FIG 5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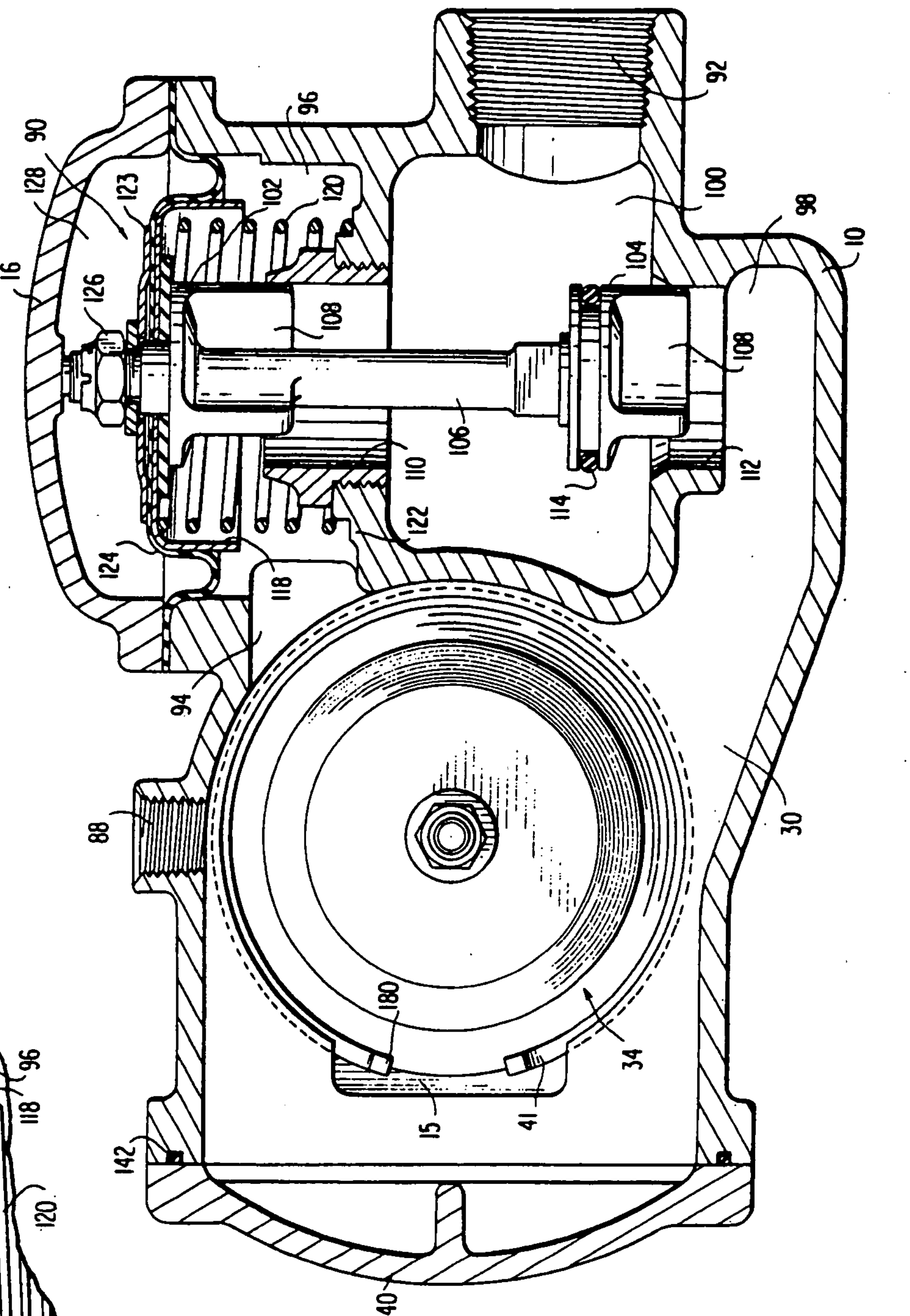

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FIG. 6

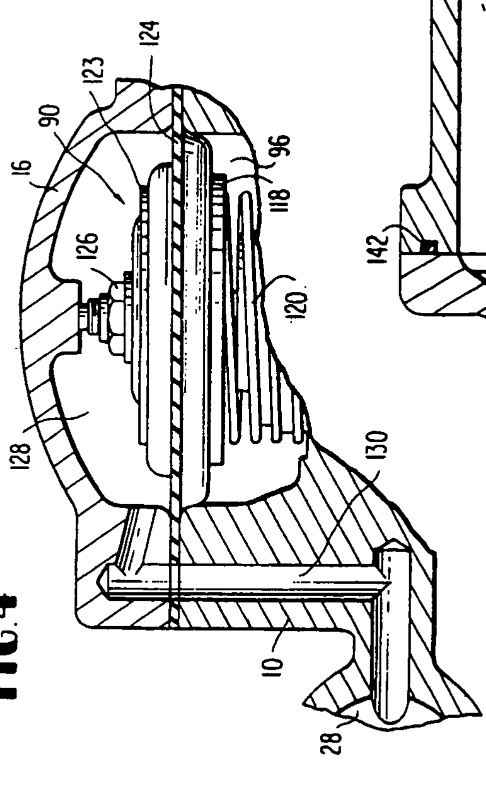

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FIG. 4

IN LINE BACK FLOW PREVENTER

This application is a continuation-in-part of U.S. application Ser. No. 890,964, filed on Mar. 28, 1978 now U.S. Pat. No. 4,232,704.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to in-line back flow preventing devices.

2. Prior Art

Back flow preventers are required equipment in all potable water supply lines where there is any possibility of reverse flow back into the supply line due to changing pressures in the supply and outlet lines.

Back flow preventers now in use generally include two check valves arranged in series so that water under sufficient pressure on the supply side will cause the valves to open and allow water to flow freely to the outlet pipes. It is also customary practice to include in the passage between the check valves, a relief valve which will automatically open should there be any flow in the reverse direction due to a drop in the supply line pressure and failure of one or both check valves to hold against higher outlet pressure. With the relief valve open, any contaminated or polluted water passing the downstream check valve in the reverse direction will be drained to atmosphere and thereby be prevented from entering the supply line.

The following U.S. Pat. Nos. are illustrative of the present state of the art: 2,389,413; 2,503,424; 3,448,763; 3,636,968; 3,747,621; 4,054,153; 4,129,144; 2,706,488; and 4,090,527.

BROAD DESCRIPTION OF THE INVENTION

An object of this invention is to provide an improved back flow preventer which minimizes the pressure drop between the inlet and the outlet, thereby permitting a higher flow capacity for a given valve size. A further object of this invention is to provide a simpler construction of back flow preventer which renders maintenance easier. Another object of this invention is to provide an improved back flow preventer which has in line check valves with one or more removable casing portions. Another object of this invention is to provide an improved in line back flow preventer having reduced dimension, as compared to prior art devices, which allows installation and removal of the check valves from the central chamber via a casing port, and which have securing means for the check valves located in the central chamber. Other objects and advantages of this invention are set out herein or are obvious herefrom to one ordinarily skilled in the art.

The objects and advantages of this invention are achieved by the apparatus and methods of this invention.

This invention is an improvement over the prior art devices insofar as it provides a back flow preventer which minimizes the pressure drop between the inlet and outlet, thereby permitting a higher flow capacity for a given valve size. At the same time this invention provides a simpler construction which renders regular maintenance easier and increases the period of use before any malfunctions occur. The pressure loss through the back flow preventer is minimized by providing a straight through flow path instead of the tortuous flow path of most back flow preventers. The device has coaxially aligned inlet and outlet openings and a straight through flow path with a pair of check valves located in the flow path. Both check valves open in the direction of the fluid flow and are spring biased to a normally closed position. The casing of the in-line back flow preventer has a removable top portion which, when removed, allows both check valve assemblies to be removed for maintenance and inspection without removing the casing from the water line and without disturbing the relief valve assembly. The retaining means for the removable check valves is internally located in central chamber of casing. The respective valve assemblies are constructed so as to prevent incorrect installation in the casing.

Should one or both of the check valves malfunction, a relief valve assembly is provided between the check valves to vent any water to atmosphere rather than allowing it to enter the water supply line. The relief valve is connected to, and actuated by a flexible diaphragm. The diaphragm, in turn, operates on the pressure differential between the inlet supply pressure and the pressure in the central chamber such that when the pressure differential goes below a predetermined point, indicating a potential back flow situation, the diaphragm opens the relief valve, thereby preventing water from entering the supply line.

During both static (no flow) and dynamic (normal flow) operating conditions of the back flow preventing valve, there are significant forces exerted on the check valve assemblies. For the check valve assembly to remain stationary, these forces have to be countered by forces exerted on the check valve assembly by the valve body through the retaining means. To appreciate the magnitude of these forces, consider a 3 inch back flow preventer valve which is subjected to a 150 psi pressure on its outlet side and zero pressure in the inlet side. (This is a potential back flow condition that the valve of this invention is specifically intended to protect against.) Assuming the sealing diameter of the 3 inch back flow preventer outlet check valve assembly is 3.87 inches, the resulting is an area exposed to the 150 psi pressure of 11.75 in^2. The force on the outlet check valve which has to be resisted by the check valve retaining means is 1760 lbs.

The retaining means shown in FIG. 2 of our copending application Ser. No. 890,964 is not adequate to consistently hold the check valve assembly stationary. Under the loading conditions, two distinct motions of the check valve assembly could occur. The check valve material, in line contact with the retaining means (a screwed pin) was overstressed, would thus yield and allow the valve assembly to move in the direction towards the central valve body chamber. The check valve assembly would also be forced to rotate (cock) under the action of the equivalent pressure force being exerted on the center line of the valve and the retaining force being exerted on the periphery of the valve. Due to this couple, the entire valve assembly would rotate and that section of the sealing O-ring, located diametrically opposite the retaining means (pin) would be pushed out of the bore in the body and no longer function as a seal.

To remedy these conditions, a retaining means which would hold the valve assembly over much of its periphery (approximately 300°) was devised. The retaining ring preferably used by this invention provides for a significant bearing area between it and the check valve assembly and between it and the valve body. The high

stress conditions previously described between the retaining pin and the groove in the check valve assembly are eliminated. The support provided by the ring is symmetrical, thus the cocking or rotation of the check valve assembly under a downstream pressure condition is also eliminated. Thus, the reliability of the check valve assembly, as a sealing member, is greatly enhanced by using the ring as the retaining means.

The internally-located retaining ring has significant manufacturing advantages over the former externally-located retaining pin. A groove in the valve body, into which the retaining ring fits can be machined during the same operation that finishes the bore which accepts the check valve assembly. This eliminates the need to drill, counter-bore and tap the mating hole for the retaining pin. Internal location also inhibits random or deliberate tampering.

The ring as a retaining means also has a servability (ease of removal) advantage over the pin. The pin and the hole in the body into which it is screwed are in continuous contact with water, therefore corrosion is likely to occur. This would result in the pin being difficult to remove after a period of time. The retaining ring on the other hand, is in a more accessible area, is not as tightly fitted as would be a pin, can be handled with pliers and a screwdriver, and thus is easily removed even if corrosion did occur. Thus, the ease of serviceability is enhanced.

Finally, the ring as a retaining means has a reliability advantage over the retaining pin, since a potential leak path between the outlet chamber and the central chamber and between the central chamber and the inlet chamber by way of the pin threads and the short gasket distance between the pin screw head and the central chamber has been eliminated by the use of a retaining ring.

The preferred check valve seat and check valve assembly retaining means of this invention is composed of a check valve seat having a circular flange located about its outer periphery, the diameter of this flange being larger that the seat diameter on which is located the sealing member (e.g., an O-ring). The bore in the valve housing which accepts the check valve assembly comprises two diameters. The smaller diameter is that which contacts the sealing member on the check valve seat. The larger diameter is larger than the check valve seat flange diameter. The shoulder in the valve housing bore provided by the diameter change, together with the abutment flange on the check valve limits the inward position of the check valve assemblies within the valve housing. The larger diameter section of the valve housing bore contains a concentric groove which extends from the shoulder at the interface with the smaller bore diameter back towards the center cavity of the housing. The width of this groove, though less than the width of the larger diameter bore, is sufficient to receive the check valve flange width and also the width of a removable retaining member. Housing material remaining at the side of the groove opposite that abuting the seat flange prevents axial movement of the check valve assembly after the retainer enters the groove.

The retaining member is most preferably a wire ring of square cross section extending around the major portion of the inside of the groove to provide a relatively large contact area. The ends of this ring extends outwardly into the check valve chamber to facilitate removal of the ring. A space between the projecting ends of the ring is provided to permit squeezing them together to reduce the ring diameter for removal. A segment of the aforementioned housing material between the side of the groove and the check valve chamber is removed to provide a space for the extending ends of the retaining member.

The retaining member, though most preferably a square cross section ring, could be any expanding type of member that could be fit into the above-mentioned groove.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. 1 is a top view of the back flow preventer according to the invention;

FIG. 2 is a longitudinal sectional view of the back flow preventer of FIG. 1 taken along lines A—A;

FIG. 3 is a transverse sectional view of the back flow preventer of FIG. 1 taken along lines B—B;

FIG. 4 is a partial sectional view of the back flow preventer of FIG. 1 taken along lines C—C;

FIG. 5 is a longitudinal sectional view of the back flow preventer of FIG. 1 with one of the snap (retainer) rings and one of the check valve assemblies in a removal (or insertion) position; and

FIG. 6 is a longitudinal sectional view of another back flow preventer of this invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIGS. 1 to 5 show a preferred embodiment of this invention usually used with a water pipe and the like having a diameter in the range of up to an inch or so. FIG. 6 shows a preferred embodiment of this invention usually used with a water pipe and the like having a diameter of 2 or more inches.

The back flow preventer of the embodiment of this invention shown in FIGS. 1 to 5 includes casing 10 having inlet 12 and outlet 14, and cover 16. Cover 16 is removably retained on casing 10 by bolts 18. Inlet 12 and outlet 14 are internally threaded as at 20 and 22, respectively, for engagement with inlet and outlet adaptors, 24 and 26. Adaptors 24 and 26 may be screwed into inlet 12 and outlet 14 to facilitate connecting the casing to appropriate diameter inlet and outlet pipes (not shown). The exact size of adaptors 24 and 26 will, of course, depend on the particular installation in which the back flow preventer is used. "O" rings 23 and 25 provide the requisite water tight sealing between the peripheries of inlet 12 and inlet adaptor 24, and outlet 14 and outlet adaptor 26, respectively.

The interior of casing 10 defines inlet chamber 28, central chamber (cavity) 30 and outlet chamber 32. Inlet chamber 28 is separated from central chamber 30 by check valve assembly 34, and central chamber 30 is separated from outlet chamber 32 by check valve assembly 36. As can be seen in FIGS. 1 and 2, the three chambers (28, 30 and 32) are coaxially aligned and, when check valve assemblies 34 and 36 are open, form a straight through flow path for the water. The elimination of the tortuous flow path of the prior art back flow preventers serves to minimize the pressure drop between the inlet and outlet, and permits a higher flow capacity for a given valve size. Obviously, this allows a higher outlet pressure to be maintained for a given inlet pressure.

Valve seat 38 is removably retained on land 42 by inner rim (abutment flange) 39 of valve seat 38 and by retaining ring 41 (retaining means). Rim 39 and retain-

ing ring 41 fit tightly in groove 19 of land 42, being retained therein by inner rim 21. The small diameter of the housing bore (forming land 42) and the adjacent shoulder in groove 19, together with abutment flange 19, limit the position of check valve assembly 34. FIG. 3 illustrates opening or breach 15 in inner rim 21 that occurs in the upper portion of thereof so that the outwardly protruding grip fingers 180 of retaining ring 41 can expand to hold check valve assembly 34 in place. Breach 15 also allows space for the forcing together of grip fingers 180 so that retaining ring 41 can be removed from groove 19. Rim 21 is housing bore large diameter material left after groove 19 has been formed (e.g., by machining). "O" ring 54 (check valve seat sealing member) provides the requisite water tight sealing between the peripheries of valve seat 38 and land 42.

Valve seat 40 is removably retained on land 44 by inner rim 43 (abutment flange) of valve seat 40 and by retaining ring 45. Rim 43 and retaining ring 45 fit tightly in groove 11 of land 44, being retained therein by inner rim 13. Opening or breach 17 in inner rim 13 occurs in the upper portion thereof so that outwardly protruding grips fingers 182 of retaining (snap) ring 45 can expand to hold check valve assembly 36 in place. Breach 17 also allows space for the forcing together of grip fingers 182 so that retaining ring 45 can be removed from groove 11-this then allows check valve 36 to be easily removed as illustrated in FIG. 5. Insertion of check valve 34 follows the reverse procedure illustrated in FIG. 5. (Breach 17 is where housing bore large diameter material 13 is removed to allow ends 182 to project into central chamber 30.) "O" ring 56 (check valve seat sealing member) provides the requisite water tight sealing between the peripheries of valve seat 40 and land 44.

Valve seat 38 has a plurality of circumferentially spaced, radially inwardly protruding legs 58 which support valve guide member 60. Any number of circumferentially spaced legs 58 may be used as long as the fluid flow through the valve seat is not unduly restricted.

Valve guide member 60 slidably supports valve stem 62 having spring retainer 64 attached to one end by retaining ring 66. Although a retaining ring engaging a peripheral groove is shown, any other suitable means to keep spring retainer 64 from sliding off the end of valve stem 62 may be used without exceeding the scope of this invention. On the opposite end of valve stem 62 is mounted disc 68, valve member 70 and backing plate 72. Valve member 70 is made of hard rubber or similar flexible material which will effectively stop the fluid flow when brought into engagement with flat lip 71 of valve seat 38. Disc 68, valve member 70 and backing plate 72 are rigidly attached to a reduced end portion 74 of valve stem 62 by deforming such end portion which protrudes beyond backing plate 72, as best shown in FIG. 2. Alternatively, reduced end portion 74 may be externally threaded and a nut used to hold disc 68, valve member 70 and backing plate 72 thereon. Obviously, any other means may be used to hold the aforementioned parts in assembled relationship without exceeding the scope of the invention. "O" ring 76 is placed around reduced portion 74 in a recess in disc 68 to prevent fluid leakage through the assembled valve. Compression spring 78 is interposed between spring retainer 64 and valve guide 60, as shown in FIG. 2, so as to normally bias valve member 70 against valve seat 38.

Valve assembly 36 is similar both in construction and operation to valve assembly 34 and, therefore, no detailed discussion is believed to be necessary except as follows. Valve seat 40 is not as wide as valve seat 38, which means protruding legs 58 of valve seat 40 are not as wide as protruding legs 58 of valve seat 38. "O" ring 56 is located before rim 43 of valve seat 40, whereas "O" ring 54 is located beyond rim 39 of valve seat 38. FIG. 2 clearly shows the construction differences.

Valve assemblies 34 and 36 cannot be assembled backwards in their respective ports because of the configuration of valve seats 38 and 40, respectively, will not allow such. Inadvertent assembly of check valve assembly 34 in place of check valve assembly 36 or vice versa can be prevented by making the external diameter of valve seats 38 slightly different from that of valve seat 40. Thus, either valve seat 38 or 40 would simply not fit into the opening intended for the other seat.

Casing 10 has internally threaded openings 84 and 86 therethrough, which openings communicate with chambers 28 and 32, respectively. A similar internally threaded opening 88 is provided in cover 16 to communicate with central chamber 30. These threaded openings may be connected to pressure gauges (not shown) or other pressure indicators or recorders to provide a visual indication of the water pressure in each chamber. If such visual indications are not desired, openings 84, 86 and 88 may be sealed by installing externally threaded plugs or stop cocks.

In the normal operating mode, check valve assemblies 34 and 36 are closed preventing any passage of water through the device. Normal water pressure in the supply line connected to inlet 12 is sufficient to overcome the force of the check valve springs and cause check valves 34 and 36 to open, thereby allowing water to flow to the outlet pipe (not shown). There will, of course, be a pressure drop as the water passes through check valves 34 and 36, but it will be minimized due to the straight-through nature of the flow path through the device.

Should the downstream pressure build up, while the inlet pressure remains relatively constant, the pressure differential across the check valves becomes smaller thereby allowing the check valve springs to close the check valves to prevent back flow through the device.

If the two check valve assemblies 34 and 36 worked perfectly, the aforedescribed device would serve to prevent back flow under any and all conditions. However, even a mechanism as simple and reliable as a check valve is subject to malfunctions (such as jamming open, foreign matter caught between the valve and valve seat, catastrophic failure of valve stem, etc.) which would render the aforedescribed device inoperative. It is of the utmost importance to prevent any possibility of malfunction since the water supply could be contaminated endangering other users of the water system.

The present device is rendered fail-safe by the inclusion of a diaphragm actuated relief valve connected between chamber 30 and a drain vent. As best seen in FIG. 3, relief valve assembly 90 is located in casing 10 displaced laterally from the axis of inlet 12 and outlet 14, and controls fluid flow out of drain vent 92. Chamber 30 communicates with valve assembly 90 via (i) passage 94 and chamber 96, and (ii) chamber 98 and port 112.

Relief valve assembly 90 comprises valve elements 102 and 104 interconnected by valve stem 106. Each of the valve elements 102 and 104 has a plurality of depending legs 108 which slidably bear against the sides of valve seat 110 and opening 112 to maintain the elements

in coaxial alignment therewith during movement of the valve assembly. "O" ring 114 is provided in a peripheral groove in valve element 104 to provide the requisite sealing when element 104 is closed. Valve element 102 comprises valve disc 116 made of hard flexible material, such as rubber, and diaphragm piston 118. Valve disc 116 bears against valve seat 110, which is threadingly attached to casing 10, to shut off the fluid flow between chamber 96 and chamber 100. Compression spring 120 bears against inner casing wall 122 and diaphragm piston 118 to normally bias relief valve assembly 90 in an open position. Relief valve assembly 90 may be attached to diaphragm 124 via nut 126 threaded onto a portion of valve stem 106 which extends through an opening in diaphragm 124 and backing plate 123.

Diaphragm 124 is made integrally with the gasket which fits between casing 10 and cover 16, and prevents communication between chamber 96 and chamber 128. (The shape of integral gasket-diaphragm 124 is best shown by the dotted line in FIG. 1.) Chamber 128 is at the inlet pressure since it communicates with inlet chamber 28 via passage 130 in casing 10, shown in detail in FIG. 4. Chamber 96 is at relatively the same pressure as chamber 30 since it communicates therewith via passage 94. The force generated by the pressure differential between chamber 128 and 96 (caused by the pressure drop across check valve assembly 34) is great enough to overcome the force of spring 120 and maintain valve elements 102 and 104 in a closed position under normal operating conditions. Thus, in normal operation, no water passes out drain vent 92. However, when a downstream pressure build-up occurs, (assuming a malfunction of either of the check valves so that they fail to close as previously described) and the pressure differential between chamber 28 and 30 (and consequently between chambers 128 and 96) drops below a predetermined point, spring 120 causes relief valve assembly 90 to open. Once the relief valve opens, the water passes out drain vent 92 rather than back into the supply line thus avoiding contamination of the water supply. Drain vent 92 may be connected to a drain pipe (not shown) to direct the water away from the location of the back flow preventer.

Vent hole 138 is provided through the wall of casing 10 and allows communication between chamber 100 and the atmosphere. Thus, if the air gap required by the plumbing code in the drain pipe (not shown) connected to drain vent 92 should inadvertently become clogged, vent hole 138 acts as a secondary air gap to prevent development of negative pressure in chamber 100. Also, if the drain pipe should become clogged, the water flowing out of vent hole 138 would give a warning of this condition.

Although relief valve assembly 90 provides adequate protection should the check valve assemblies malfunction, this invention also by its construction provides means to minimize the chances of such a malfunction occurring. Backing plate 72 can contain a recessed annular portion adjacent to its periphery. If valve stem 62 and valve guide 60 should become worn enough to enable valve stem 62 to become skewed with respect to valve guide 60, such recessed portion would allow one side of valve member 70 to deflect so as to ensure the seating of valve member 70 on the entire circumference of valve seat 38. Backing plate 72 can have a peripheral flange spaced from the periphery of valve element 70 so as to allow water to pass into the annular space defined by the recessed portion. The build-up of downsteam water pressure, which cause the check valve to close, will assist in the seating of valve element 70 against valve seat 38 due to the water entering the annular space and acting against flexible valve member 70. A similarly shaped backing plate can be used on check valve assembly 36.

FIG. 5 illustrates the ease of removal and insertion of the check valve assemblies 34 and 36. FIG. 5 also shows the advantage of this invention of a smaller back flow preventer, which is a large savings in construction material alone.

FIG. 6 shows another preferred enbodiment of this invention. FIG. 6 is similar to FIG. 3. The embodiment of FIG. 6 is nearly the same as the embodiment of FIG. 3 except for the following enumerated differences. Entry into central chamber 30 is through a side port, enclosed by cover 140. "O"-ring 142 located in a peripherial groove in casing 10 provides the requisite watertight sealing between casing 10 and covering 140. Check valve assemblies 34 and 36 are inserted and removed through the side port covered by cover 140. In FIG. 6, it is seen that cover 16 does not extend over central chamber 30 and only covers the relief valve assembly. This embodiment therefore has two separate ports and covers (16 and 140). Diaphragm 124 does not extend over the top rim of area of central chamber 30 as in FIG. 3 as there is no top entry port in this embodiment. This embodiment is normally used with larger liquid flow pipes (usually at least 2 inches in diameter).

The pertinent portions of applicants' commonly-assigned U.S. application Ser. No. 890,964, filed on Mar. 28, 1978, is incorporated herein by reference.

What is claimed is:

1. A device for preventing the back flow of water from a point of use into a water supply line comprising:
(a) a unitary casing having a water inlet opening, a water outlet opening and a drain vent opening, said water inlet and water outlet openings being coaxially aligned, the interior of said casing defining an inlet chamber, a central chamber and an outlet chamber, said chambers being coaxially aligned with each other and with said water inlet and water outlet openings to form a straight through flow path for the water, said interior of said casing also defining a drain vent chamber communicating with said drain vent opening and said central chamber, and said drain vent chamber being offset from said coaxially aligned inlet, central and outlet chambers;
(b) a first check valve assembly removably attached to the interior of said casing between said inlet and central chambers, said first check valve being biased in a closed position to prevent the flow of water therethrough and opening to permit the flow of water therethrough when the water pressure in the water inlet chamber exceeds a predetermined level;
(c) a first removable retaining means for retaining said first check valve assembly in said attached position, said first removable retaining means being located in said central chamber;
(d) a second check valve assembly removably attached to the interior of said casing between said central and outlet chambers, said second check valve being biased in a closed position to prevent flow of water therethrough and opening to permit the flow of water therethrough when the water pressure in said central chamber exceeds a predetermined level;

(e) a second removable retaining means for retaining said second check valve assembly in said attached position, said second removable retaining means being located in said central chamber;

(f) a relief valve located within said casing interposed between said central chamber and said drain vent chamber, said relief valve being offset from said coaxially aligned inlet, central and outlet chambers, and said relief valve being biased in an open position;

(g) a flexible diaphragm attached to said casing and to said relief valve, one side of said diaphragm communicating with said central chamber and the other side of said diaphragm communicating with said inlet chamber, such that the normal pressure differential between said inlet and central chamber causes said relief valve to close thereby preventing water flowing from said central chamber to said drain vent chamber; and

(h) a cover removably attached to said casing over an opening therein such that upon removal of said cover, said first and second check valve assemblies being removable from said casing interior without removal of said flexible diaphragm.

2. The back flow preventing device of claim 1 wherein said first check valve assembly comprises (a) a first valve seat having an external annular shoulder, (b) a first valve member movable between an open position wherein said first valve member is displaced away from said first valve seat and a closed position wherein said first valve member is in contact with said first valve seat, and (c) first biasing means to bias said first valve member to a normally closed position, said first removable retaining means comprising an expandable ring which has a gap therein and has a gripping arm on each end thereof which is located at a right angle to the plane of said expandable ring, and said interior attachment portion of said casing between said inlet and central chambers containing an annular groove, the rim or lip thereof facing said inlet chamber having an internal diameter less than the external diameter of said external annular shoulder of said first valve seat and the rim or lip thereof facing said central chamber having an internal diameter greater than the external diameter of said external annular shoulder of said first valve seat, and said expandable ring fitting in said groove so as to tightly hold said external annular shoulder in said groove and being removable from said groove upon compression thereof.

3. The back flow preventing device of claim 2 wherein said first biasing means comprises a compression spring.

4. The back flow preventing device of claim 2 wherein said first valve member comprises:

(a) a first valve stem slidably attached to said first valve seat;

(b) a first valve element of flexible material attached to an end of said first valve stem, said first valve element contacting said first valve seat when said first valve member is in a closed position; and

(c) a first backing plate attached to said end of said first valve stem, said first backing plate having a recessed portion adjacent to its periphery to allow deflection of said first valve element so as to ensure seating of said element against said first valve seat even if said first valve stem should becomed skewed with respect to said first valve seat.

5. The back flow preventing device of claim 1 wherein said second check valve assembly comprises (a) a first valve seat having an external annular shoulder, (b) a second valve member movable between an open position wherein said second valve member is displaced away from said second valve seat and a closed position wherein said second valve member is in contact with said second valve seat, and (c) second biasing means to bias said second valve member to a normally closed position, said second removable retaining means comprising an expandable ring which has a gap therein and has a gripping arm on each end thereof which is located at a right angle to the plane of said expandable ring, and said interior attachment portion of said casing between said central and outlet chambers containing an annular groove, the rim or lip thereof facing said outlet chamber having an internal diameter less than the external diameter of said external annular shoulder of said second valve seat and the rim or lip thereof facing said central chamber having an internal diameter greater than the external diameter of said external annular shoulder of said second valve seat, and said expandable ring fitting in said groove so as to tightly hold said external annular shoulder in said groove and being removable from said groove upon compression thereof.

6. The back flow preventing device of claim 5 wherein said second biasing means comprises a compression spring.

7. The back flow preventing device of claim 5 wherein said second valve member comprises:

(a) a second valve stem slidably attached to said second valve seat;

(b) a second valve element of flexible material attached to an end of said second valve stem, said second valve element contacting said second valve seat when said second valve member is in the closed position;

(c) a second backing plate attached to said end of said second valve stem, said second backing plate having a recessed portion adjacent to its periphery to allow deflection of said second valve element so as to ensure seating of said element against said second valve seat even if said second valve stem should become skewed with respect to said second valve seat.

8. The back flow preventing device of claim 1 wherein said relief valve comprises:

(a) a first relief valve seat removably attached to the interior of said casing;

(b) a second relief valve seat formed integrally with the interior of said casing;

(c) a first relief valve element movable between an open position wherein said first relief valve element is displaced from said first relief valve seat and a closed position wherein said first relief valve element contacts said first relief valve seat;

(d) a second relief valve element movable between an open position wherein said second relief valve element is displaced from said second relief valve seat and a closed position wherein said second relief valve element contacts said second relief valve seat;

(e) a valve stem connecting said first and second relief valve elements;

(f) means connecting said first relief valve element to said flexible diaphragm; and

(g) biasing means to normally bias said first and second relief valves in an open position.

9. The back flow preventing device of claim 1 wherein said biasing means is a compression spring.

10. The back flow preventing device of claim 1 wherein said flexible diaphragm is formed integrally with a gasket located between said casing and said cover, said gasket having an opening therethrough which allows removal of said check valve assemblies from said casing without disturbing said flexible diaphragm.

11. The back flow preventing device of claim 1 wherein said first and second check valve assemblies are of different size so as to not be interchangeable.

12. The back flow preventing device of claim 1 wherein said casing has a hole therethrough allowing communication between said drain vent chamber and ambient atmosphere, said hole functioning as a drain upon closing of said drain vent opening.

* * * * *

United States Patent [19]

Griswold et al.

[11] **4,333,495**

[45] **Jun. 8, 1982**

[54] **CHECK VALVE ASSEMBLY**

[75] Inventors: **David E. Griswold**, Corona Del Mar; **Richard E. Veit**, Morro Bay, both of Calif.

[73] Assignee: **Griswold Controls**, Irvine, Calif.

[21] Appl. No.: **183,583**

[22] Filed: **Sep. 2, 1980**

Related U.S. Application Data

[60] Division of Ser. No. 10,987, Feb. 9, 1979, Pat. No. 4,244,395, which is a continuation-in-part of Ser. No. 410,173, Oct. 26, 1973, abandoned.

[51] **Int. Cl.³** **F16K 15/02**

[52] **U.S. Cl.** **137/484.2**; 137/218; 137/512; 137/614.2; 137/540

[58] **Field of Search** 137/218, 484.2, 512, 137/540, 614.2

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Primary Examiner—Harold W. Weakley

Attorney, Agent, or Firm—Lyon & Lyon

[57] **ABSTRACT**

A check valve assembly employs a poppet slidably mounted in a stationary barrel to engage a seat in the barrel. The poppet and barrel cooperate to form a closed chamber containing a spring which acts to close the poppet against the seat, but the force of the spring is partially overcome by a reduction in pressure in the chamber caused by venturi action by forward flow through the check valve assembly with the result that higher upstream pressure is needed to open the valve than to maintain it in open position, at least for low and medium flow rates. Two identical check valve assemblies are connected in series, the assemblies being perpendicular to each other, each mounted at about a 45° angle with respect to coaxial inlet and outlet terminals.

2 Claims, 5 Drawing Figures

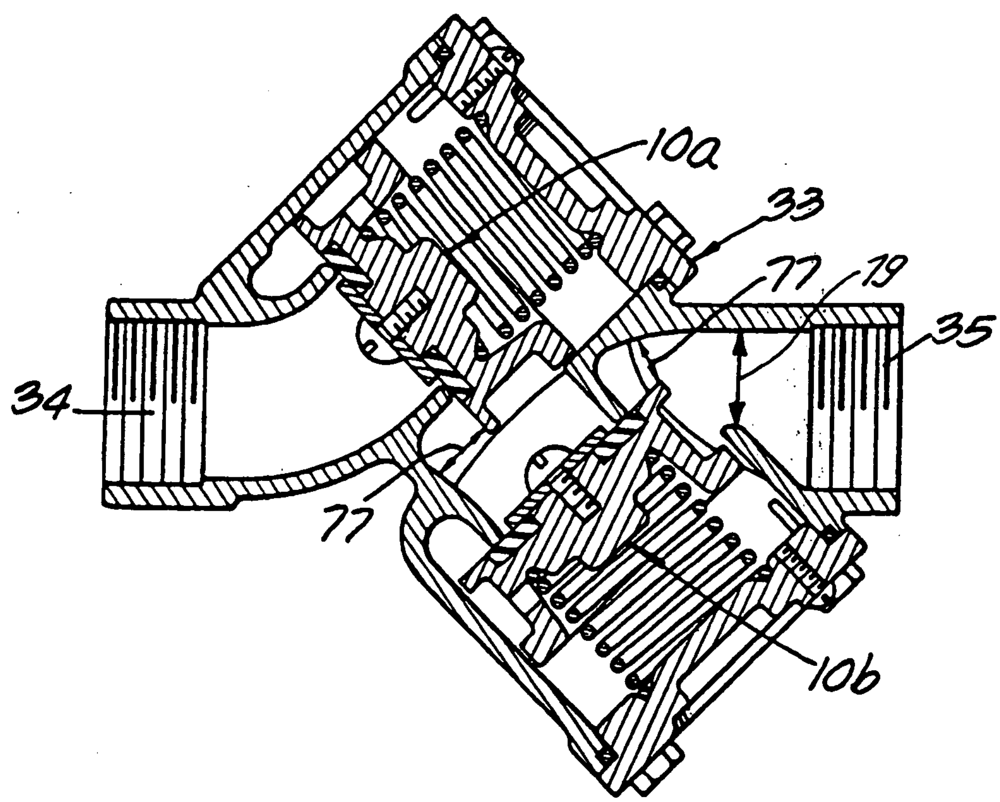
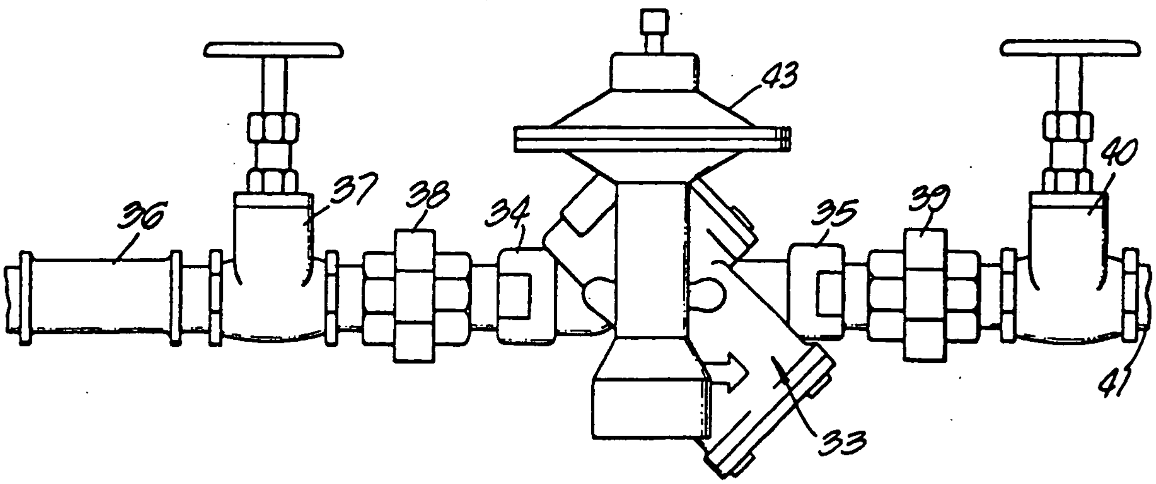


FIG. 1.



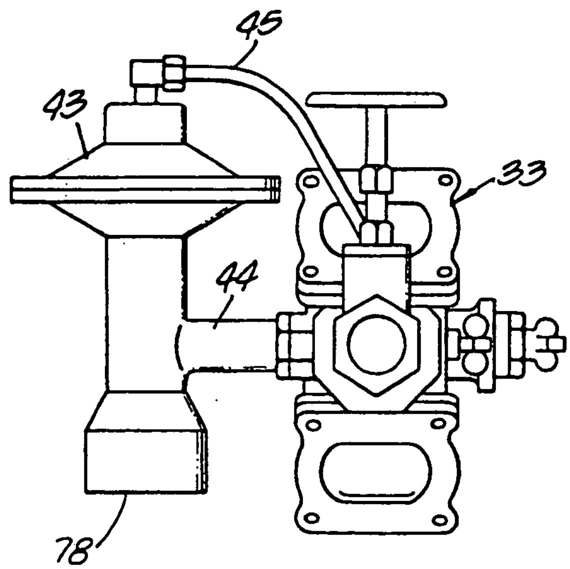


FIG. 2.

FIG. 4.

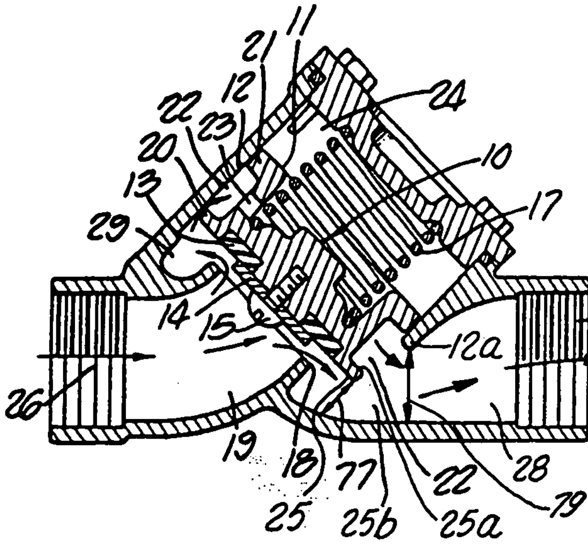


FIG. 3.

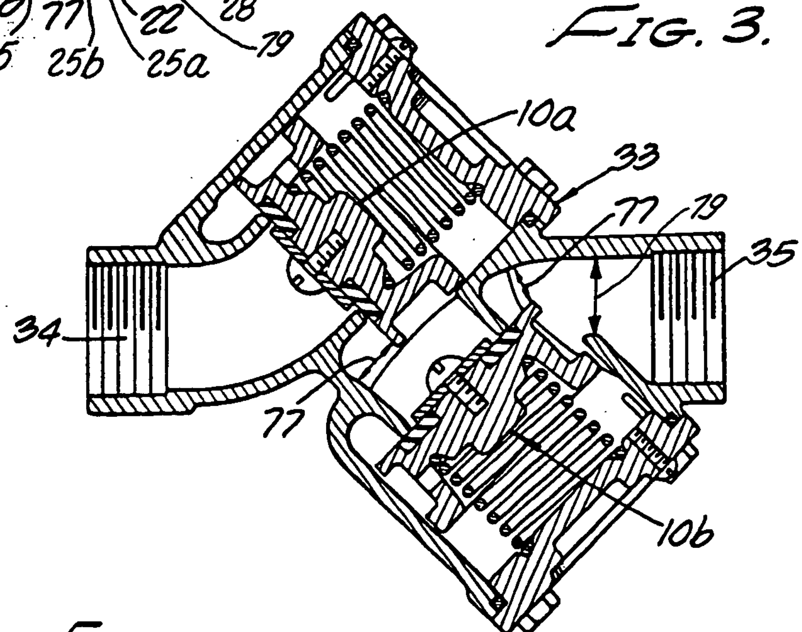
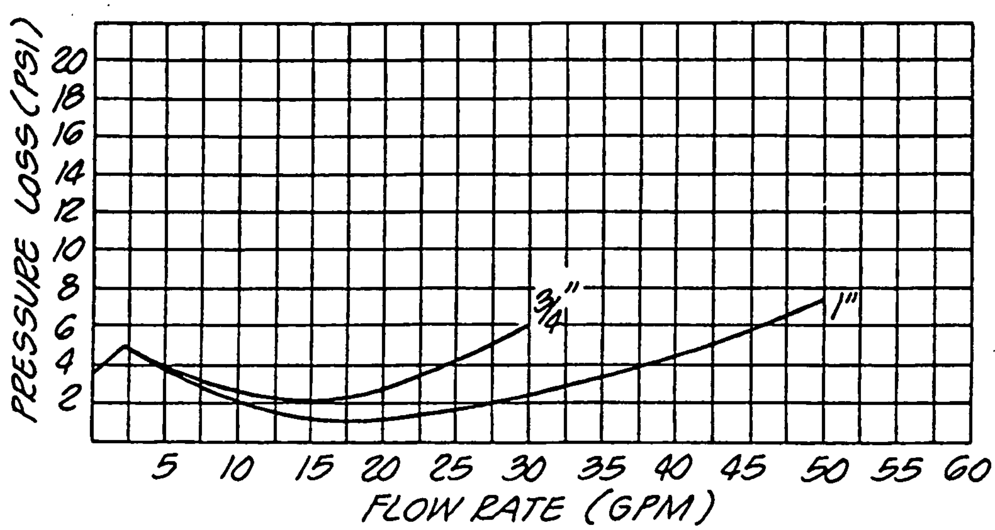


FIG. 5.



CHECK VALVE ASSEMBLY

This application is a division of Ser. No. 10,987 filed Feb. 9, 1979, entitled "Check Valve Assembly", now U.S. Pat. No. 4,244,395, which is a continuation-in-part of application Ser. No. 410,173 filed Oct. 26, 1973 and entitled "Backflow Prevention Apparatus", now abandoned.

This invention relates to fluid flow apparatus and is particularly directed to improvements in check valve construction.

Check valves are commonly provided when it is desired to permit fluid flow in one direction but to prevent fluid flow in the other direction. A single check valve acting alone may leak slightly and, therefore, single check valves are not used when it is necessary to prevent any reverse flow, even in the smallest degree. In the latter situation, backflow prevention apparatus may take the form of two check valves connected in series with a "zone" between them. Both check valves remain open during normal flow in a forward direction, but in the event that the downstream pressure should approach the upstream pressure within a predetermined amount, for example, two pounds per square inch, the volume of the zone between the check valves is vented to atmosphere. In such devices, downstream pressure can never exceed upstream pressure, even under vacuum conditions, with the result that reverse flow is not possible.

Backflow prevention devices of the type just described have at least two serious shortcomings. The first is that, in order to have a check valve which will close satisfactorily, and more significantly, in certain cases, maintain a predetermined minimum pressure, a spring force is used, and this must be overcome during normal flow in the forward direction. Unfortunately, this often results in a pressure drop of serious proportions, particularly when two check valves in series are employed. Another difficulty is that conventional apparatus for venting the zone between the check valves is usually costly, inaccurate and difficult to maintain.

Accordingly, it is the principal objective of this invention to provide check valves suitable for use in backflow prevention equipment and that are constructed to both provide a relatively high initial resistance to pressure and flow and yet as the demand for flow increases, cause the corresponding pressure drop to be at a minimum value.

Other and more detailed objects and advantages will appear hereinafter.

In the drawings:

FIG . 1 is a side elevation of a complete backflow preventer assembly employing check valves embodying this invention.

FIG. 2 is an end elevation of the device shown in FIG. 1.

FIG. 3 is a sectional elevation of the double check valve assembly shown in FIGS. 1 and 2, both check valves being shown in closed position. FIG. 3 shows a preferred embodiment of this invention.

FIG. 4 is a sectional elevation showing a single check valve assembly, the valve assembly being shown in open position.

FIG. 5 is a graph showing pressure loss plotted against flow rate in a commercial form of the double check valve assembly shown in FIG. 3. One curve of the graph relates to a device of three-quarter inch nominal size, and another curve relates to a device of one inch nominal size.

Referring to the drawings, the backflow preventer assembly shown in FIGS. 1 and 2 includes a double check valve assembly 33 having its inlet terminal 34 connected to a supply pipe 36 through a shutoff valve 37 and a union coupling 38. The outlet terminal 35 of the double check valve assembly 33 is connected through union coupling 39 and shutoff valve 40 to the service pipe 41. The check valve assembly shown in FIG. 4 and generally designated 10 includes a poppet 11 slidably mounted within a cylindrical surface in the stationary barrel 12. An annular resilient seal 13 serves as a valve face and is held in place on the poppet 11 by means of a retaining washer 14 and a threaded fastening 15. A coil compression spring 17 acts on the poppet 11 to bring the resilient ring 13 into sealing engagement with the stationary annular seat 18 provided at the end of the inlet passage 19.

The poppet 11 has a first flange 20 and a second flange 21 both slidably mounted within the stationary barrel 12. An annular groove 22 is defined between the flanges 20 and 21, and one or more ports 23 establish communication between the groove 22 and the spring chamber 24. The first flange 20 has a first annular surface 25 co-planar with the sealing surface of the seal ring 13 and extending radially outward therefrom. The flange 20 also has a second surface 25*a* on the other side of the flange which forms one side of groove 22. The wall portion 12*a* of the inclined barrel 12 extends into the discharge passage 28 so that when flow takes place the discharge pressure is not reflected into the spring chamber 24.

In FIG. 4, the inlet terminal 26 and the outlet terminal 27 are coaxial, and the axis of movement of the poppet 11 is positioned at about 45° with respect thereto. The parts are shown in open position. Fluid in the inlet 19 passes between the annular seat 18 and the resilient ring 13 into the outlet passage 28. Inlet pressure is then present in annular region 29 acting upon the total pressure area of the flange 20 to overcome the force of the spring 17. Thus, flange 20 effectively serves as a restriction seal between the pressure region 29 and the annular groove 22.

The outer diameters of the poppet flanges 20 and 21 are substantially larger than the effective diameter of the stationary seat 18, so that when the poppet valve 11 is in closed position with the resilient ring 13 engaging the seat 18, the pressure in the inlet passage 19 acts over a substantially smaller area than the pressure in the spring chamber 24. When the pressure in the inlet passage 19 applied across the area of seat 18 is sufficient to overcome the force of the spring 17 and the pressure in the spring chamber 24, both the static and the dynamic head are subsequently applied to the larger effective area of the flange 20. Thus, the increase in effective area when the poppet valve 11 first opens results in a substantial force to overcome the spring force, and the poppet 11 moves toward open position.

When the check valve parts are in open position corresponding to forward flow operation, as shown in FIG. 4, the flow of the fluid creates a low pressure region around the poppet 11 in the groove 22. This occurs because a portion of the flange 20 and a portion of the groove 22 extend into the region 25*b*. This reduced pressure is reflected into the spring chamber 24 through the groove 22 and through the port or ports 23, as well as through the clearance between the flange 21

and the barrel **12**. Consequently, as the velocity of forward flow increases, the unit pressure in the chamber **17** decreases over the effective area defined by the diameter of flange **20**.

When the pressure in the outlet passage **28** falls below a predetermined value, as compared to the pressure in the inlet passage **19**, the portion of the poppet **11** which protrudes into the outlet passage **28** receives the full pressure of the liquid just prior to threatened reverse flow, and the force as thus developed acts over the full effective area of spring chamber **24**, which combined with the force of the spring **17** acts to close the valve promptly.

It will be observed that, in the construction just described, as the velocity of forward flow increases, the velocity head produces a positive opening force on the poppet **11** on the side containing the resilient seal **13**, together with a lowering of unit pressure in the chamber **24**, both effects serving to oppose the force of the spring **17**. Moreover, the lowering of pressure in the spring chamber **24** is developed due to the portion of the poppet flange **20** protruding into the outlet passage **28** and creating a restriction **77** in which the momentum of fluid flow acting upon the static fluid in groove **22** results in the lowering of pressure in groove **22** and transmitted to the spring chamber **24** through the communicating port **23**. A second restriction **79** exists between the wall portion **12***a* of the barrel **12** and the interior surface of the outlet passage **28**. Consequently, as the demand for flow increases, the resulting momentum increase results in an ever decreasing pressure in the spring chamber. Concurrently, as the rate of flow increases, the velocity head acting upon the full effective area of flange **20** (on the side with the resilient seal) increases. With both effects thus combined, a substantial pressure differential is created across the flange **20** to create an increasing force to overcome the force of the spring **17**. Furthermore, even with the introduction of restriction **77** and a consequent "induced" pressure drop in the region **25***b*, the net result is an advantageous pressure differential across the poppet **11** and a reduction in the total pressure drop across the valve assembly. Moreover, the spaced flanges **20** and **21** guide the poppet in its movements within the barrel **12** with adequate clearances to avoid mechanical frictional losses and to minimize mechanical malfunctions. The absence of guide pins, toggle levers, etc., also assists in the reduction of mechanical friction.

The double check valve assembly generally designated **33**, shown in FIG. **3**, employs two duplicate check valve assemblies **10***a* and **10***b* which are substantially the same as the check valve **10** described in detail above. These check valve assemblies are arranged at right angles, the check valve **10***a* assembly being positioned at 45° to the axis of the inlet terminal **34** and the check valve assembly **10***b* being at 45° to the axis of the outlet terminal **35**. The construction and operation of each of these check valve assemblies **10***a* and **10***b* is the same as that of the check valve assembly **10** described above. Moreover, the geometric relationship of the assemblies **10***a* and **10***b* as shown in FIG. **3** produces a uniform flow pattern by minimizing the extent of the changes in direction of flow and the extent of obstructions to forward flow, thus minimizing fluid pressure losses.

The chart of FIG. **5** shows the pressure loss through the double check valve assembly of FIG. **3**, for both the nominal size of three-quarter inch and the nominal size of one inch. It will be observed that the pressure loss through the assemblies **10***a* and **10***b* actually falls off as the flow rate increases, up to about 15 gallons per minute for the three-quarter inch size and up to about 18 gallons per minute for the one inch size. This pressure drop is so low that three inch nominal size double check valves embodying this invention are able to meet the standards for four inch nominal size check valves of conventional type, thereby producing an important competitive advantage.

It will be observed that the moving parts of each check valve assembly **10***a* and **10***b* may be installed and removed independently without any need to disconnect the entire assembly from the line. Moreover, each check valve assembly is so arranged as to utilize the full impact of the dynamic pressure in the supply line when in forward flow operation, for effectively minimizing hydraulic pressure losses. Furthermore, each check valve assembly is so arranged as to have portions of the poppet thereof protruding into its respective discharge passage, or in communication with its discharge passage, so as to be responsive to the slightest action toward reverse flow, closing spontaneously to prevent backflow.

The differential control valve **43** is responsive through line **45** to the pressure in the inlet **19**, and is responsive through a pipe **44** to the zone **52** between the check valves **10***a* and **10***b*.

The chamber **52** is vented to atmosphere through pipe **44** and outlet **78** whenever the downstream pressure in the region of the terminal **35** approaches the upstream pressure in the region of the terminal **34** within a predetermined amount, for example, two pounds per square inch. The construction and operation of the control valve assembly **43** are described in detail in our copending application Ser. No. 10,934, filed Feb. 9, 1979 and entitled "Backflow Prevention Apparatus".

Having fully described our invention, it is to be understood that we are not to be limited to the details herein set forth but that our invention is of the full scope of the appended claims.

We claim:

1. In a double check valve assembly having two duplicate check valves connected in series, the upstream check valve having an inlet terminal and the downstream check valve having a discharge terminal, said terminals being axially aligned, and a passage constituting the discharge passage for the upstream check valve and the inlet passage for the downstream check valve, the improvement comprising, in combination: each check valve having a stationary annular valve seat, and having a stationary barrel positioned coaxially of said valve seat, each check valve having a valve poppet guided for axial movement in its respective barrel and having a seal element adapted for sealing contact with its respective valve seat, each check valve having a spring acting to move its respective valve poppet into sealing contact with said valve seat, each valve poppet having an axis of movement disposed at an angle of about 45° with respect to the axis of said coaxial terminals, and each valve poppet having an axis of movement at substantially right angles to the axis of movement of the other valve poppet.

2. In a double check valve assembly having two duplicate check valves connected in series, the upstream check valve having an inlet terminal and the downstream check valve having a discharge terminal, said terminals being axially aligned, and a passage constitut-

ing the discharge passage for the upstream check valve and the inlet passage for the downstream check valve, the improvement comprising, in combination: each check valve having a stationary valve seat, and having a stationary barrel positioned coaxially of said valve seat, each check valve having a valve poppet mounted for axial sliding movement in its respective barrel and having a seal element adapted for sealing contact with its respective valve seat, means cooperating with each barrel and its respective valve poppet to define a chamber remote from its respective valve seat, each check valve having a spring acting in cooperation with fluid pressure in its respective chamber to move its respective valve poppet into sealing contact with said valve seat, each valve poppet having an axis of movement disposed at an angle of about 45° with respect to the axis of the coaxial terminals, each valve poppet having an axis of movement at substantially right angles to the axis of movement of the other valve poppet, means on each valve poppet and its respective barrel for establishing a localized zone of relatively rapid flow and consequent reduced pressure when forward flow occurs through the check valve assembly, and means on each valve poppet for establishing communication between its localized zone and its respective closed chamber, so that forward flow of fluid through said double check valve assembly causes a reduction of pressure in each chamber, whereby pressure drop through said double check valve assembly initially falls with increasing flow.

* * * * *

United States Patent [19]

Hunter

[11] **4,357,954**

[45] **Nov. 9, 1982**

[54] **BACKFLOW PREVENTING VALVE CONSTRUCTION**

[75] Inventor: **Edwin J. Hunter**, Rancho Santa Fe, Calif.

[73] Assignee: **The Toro Company**, Minneapolis, Minn.

[21] Appl. No.: **170,854**

[22] Filed: **Jul. 21, 1980**

[51] **Int. Cl.³** **F16K 24/00**

[52] **U.S. Cl.** **137/218**; 137/529; 137/535; 137/540; 251/61.1

[58] **Field of Search** 137/529, 535, 540, 543.15, 137/218; 251/61.1

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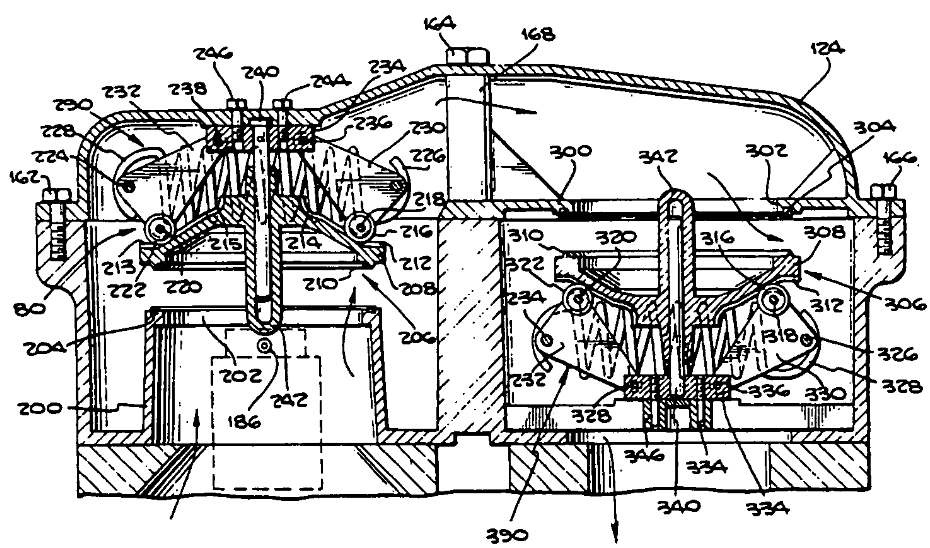
Primary Examiner—H. Jay Spiegel

Attorney, Agent, or Firm—Poms, Smith, Lande & Rose

[57] **ABSTRACT**

An improved check valve for a backflow preventing valve of the type having an inlet passage, an intermediate chamber, and an outlet passage, includes a stationary valve port fluidly communicating with the intermediate chamber, a movable contoured valve seat for sealing the port, and a valve closing apparatus in rolling engagement with the valve seat and responsive to the pressure differential thereacross. The valve closing apparatus urges the valve seat to a valve closed position and includes a stationary shaft, a pair of rollers, and a spring. The spring biases the rollers against the contoured valve seat to thereby effect the closure of the seat member against the valve port. An improved exhaust valve is also provided and includes a balanced valve member providing a path between the intermediate chamber and the atmosphere when in a valve open position. The balanced valve member is resiliently biased between a valve seat and a moveable diaphragm. The diaphragm compares the inlet passage and intermediate chamber pressures and maintains the valve closed when the inlet passage pressure is greater than the intermediate chamber pressure, while moving to absorb fluid displacements from the intermediate chamber caused by large reductions in the inlet passage pressure.

15 Claims, 5 Drawing Figures



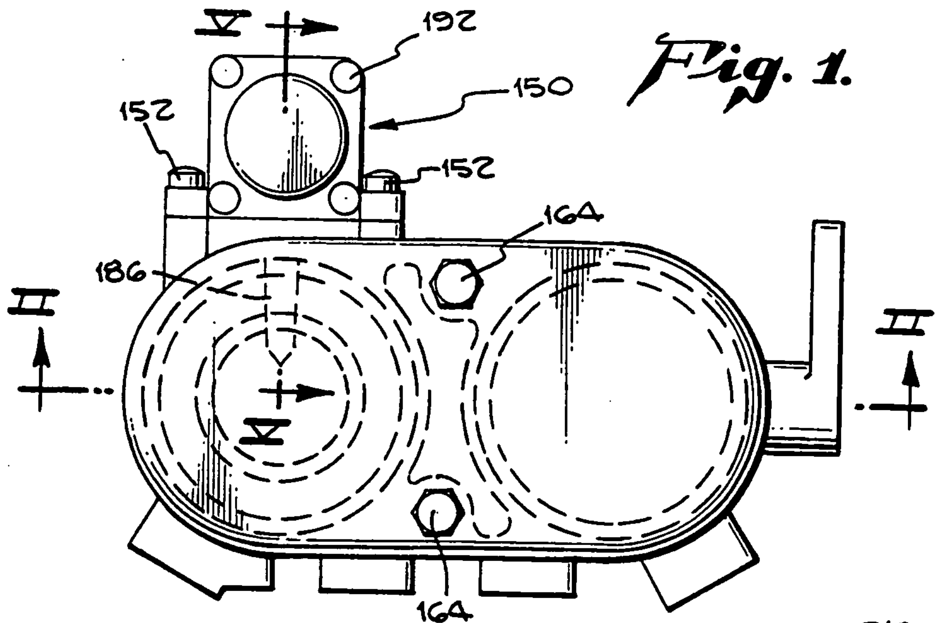

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Fig. 1.

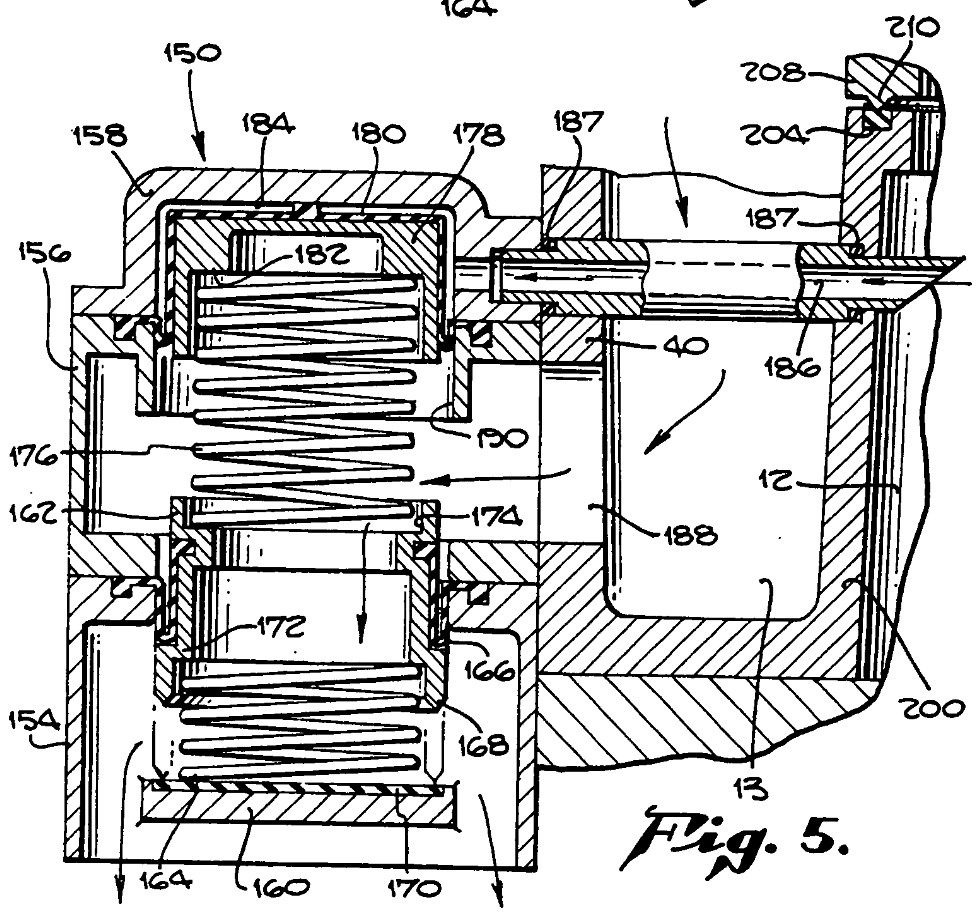
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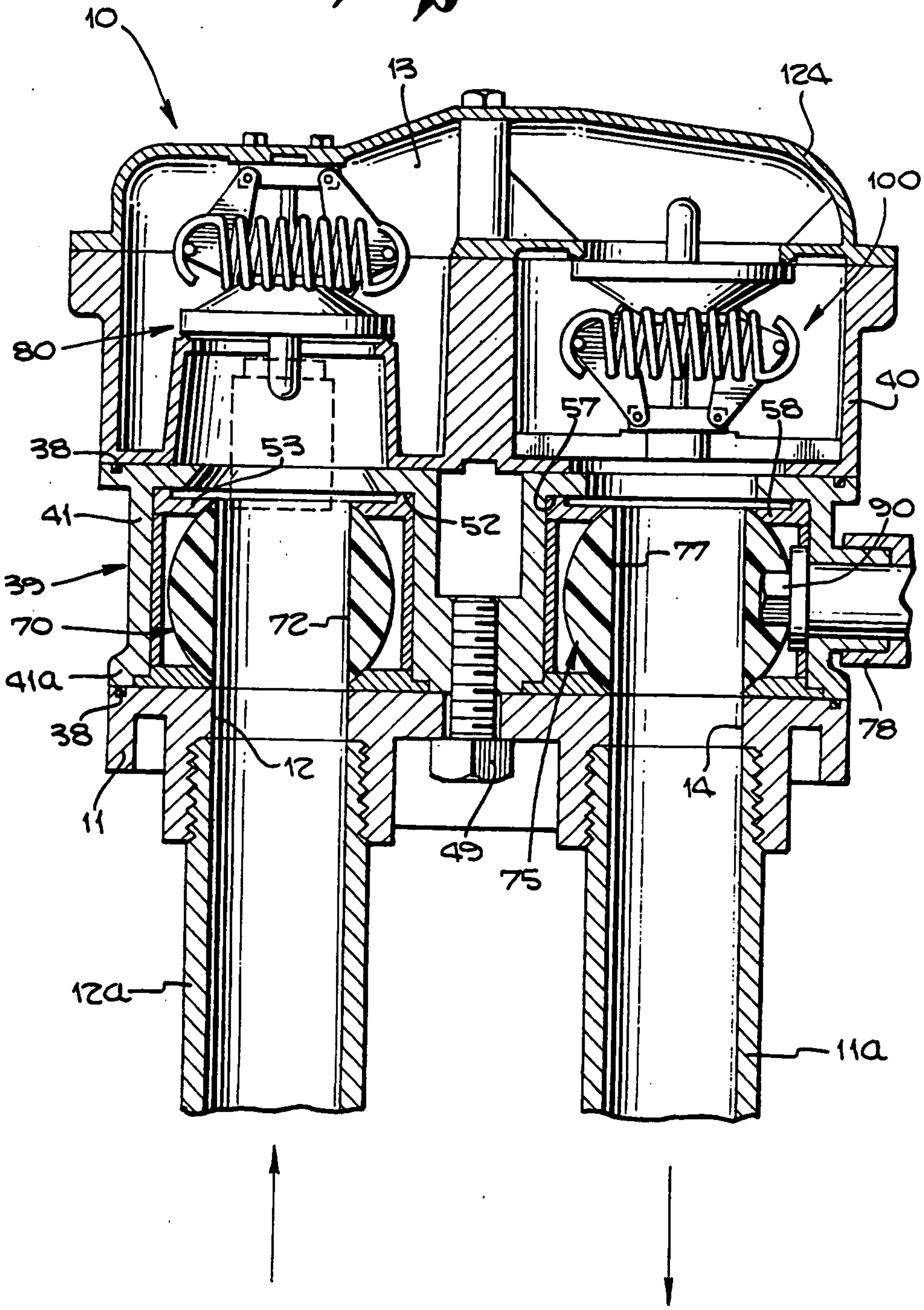
Fig. 5.

Fig. 2.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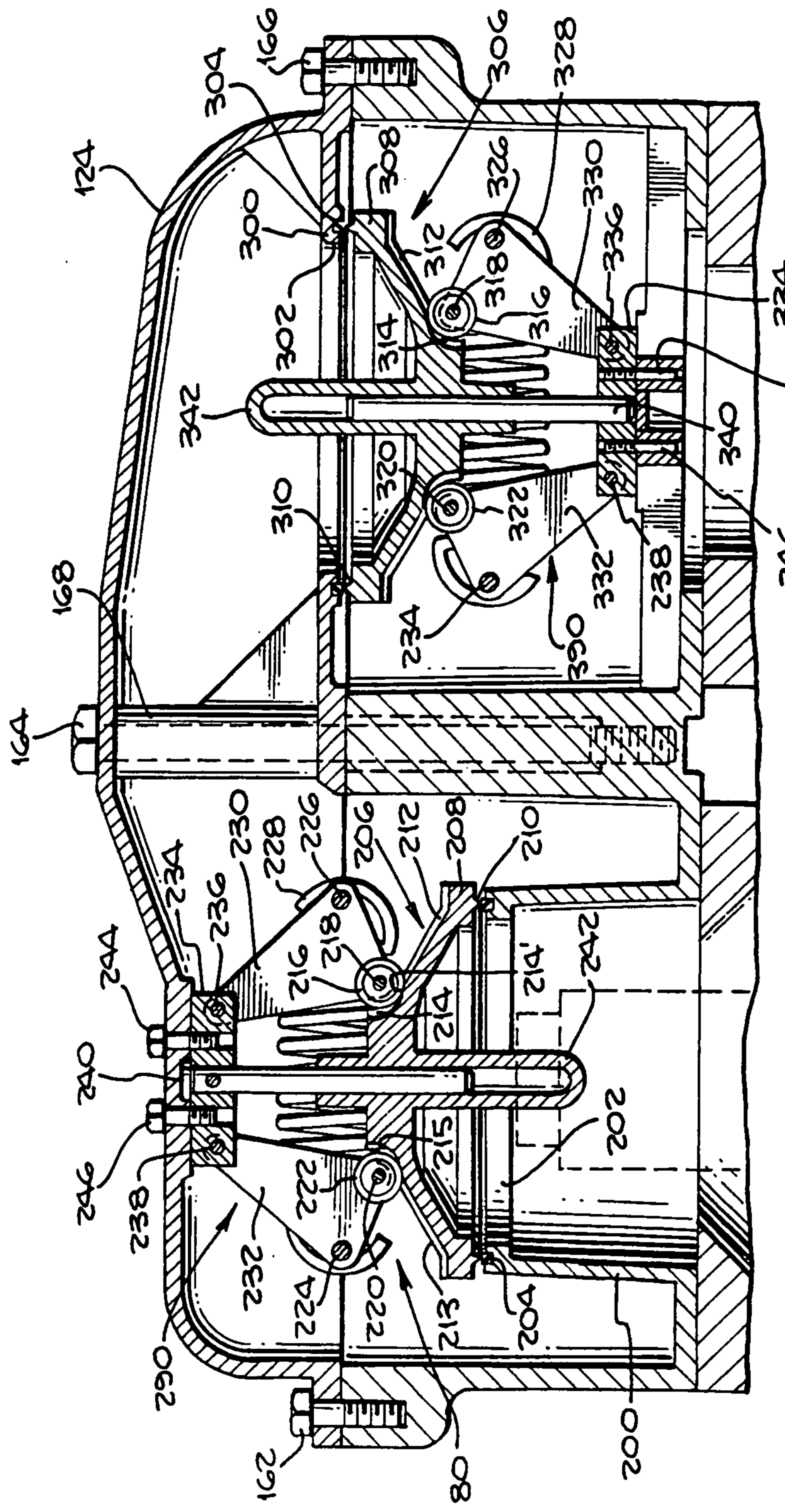
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Fig. 3.

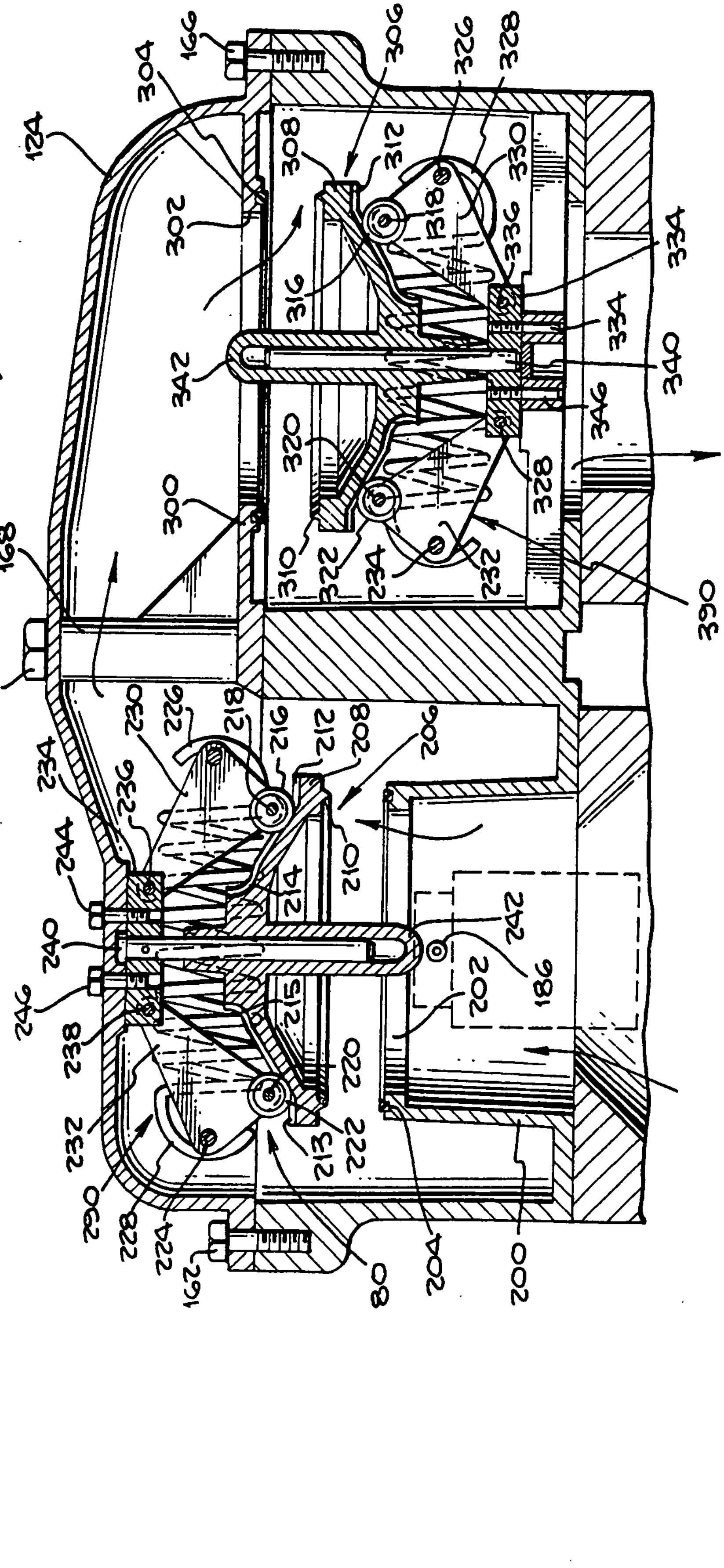
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Fig. 4.

BACKFLOW PREVENTING VALVE CONSTRUCTION

FIELD OF THE INVENTION

The present invention relates in general to backflow preventing valves and in particular to check valve and exhaust valve constructions for use in backflow preventing valves.

BACKGROUND OF THE INVENTION

Backflow preventing valves are used in irrigation systems and the like to ensure unidirectional fluid flow. In large irrigating systems, various fertilizers and nutrients are typically mixed in with the water that is sprayed or otherwise supplied to crops. As a municipal water main usually provides a common supply of water for all domestic and commercial uses in an area, it is important to prevent the backflow of these fertilizers and nutrients to avoid contaminating the portion of the water used for domestic purposes.

Much effort has been expended in the development of backflow preventing valves which quickly close under conditions which normally cause backflow, such as back pressure or siphonage. As the usual design for a backflow preventing valve includes an inlet passage and an outlet passage, each respectively communicating with an intermediate chamber via an inlet check valve and an outlet check valve, much work has been done to develop the inlet and outlet check valve portions of the backflow preventing valves to ensure a rapid and definite closure for increases in the pressure of the fluid in the outlet passage relative to that in the inlet passage.

For example, in my prior U.S. Pat. No. 3,724,487, I disclosed a backflow preventing valve utilizing a check valve design having a spring urging a piston-type valve seat into a valve port. In my U.S. Pat. No. 4,080,980, I disclosed an improvement to my previous patent in which the inlet and outlet check valves included a booster means cooperating with the spring for forcibly closing the valve without providing an undesirable increased resistance to opening after reaching an initial opened position. The booster means included a cylindrical shaft having rollers biased thereon. When the valve was approaching a closed position, the rollers entered a reduced portion of the shaft which, in combination with a spring biasing the rollers against the shaft, assisted the piston spring in forcibly closing the valve.

Other booster designs have included contoured valve seat stems providing camming surfaces for rollers that are resiliently biased thereagainst. These camming surfaces and rollers maintain a uniform force on the stem after the valve has initially opened and assist the spring in closing the valve. In general, however, the check valve camming arrangements found in the prior art require several moving parts and provide only a limited amount of boost, and are limited in the manner in which the boost is applied.

Developments have also been made in the design of the exhaust valve portion of the backflow preventing valve. The exhaust valve communicates with the inlet passage and intermediate chamber and is used to gate the intermediate chamber fluid to the atmosphere when the pressure in the intermediate chamber rises relative to the inlet passage pressure as the inlet and outlet check valves are closing in a backflow situation. The problem plaguing most exhaust valves is that intermediate chamber fluid is gated to the atmosphere for only transient

pressure increases of the intermediate chamber fluid relative to the inlet passage fluid. This pressure increase is caused by displacement of the intermediate chamber fluid as large pressure reductions occur in the inlet passage fluid. This "spitting" by the exhaust valve is undesirable for such momentary pressure increases.

The exhaust valves of the prior art generally have not solved the "spitting" problem, as they generally employ unsophisticated valving arrangements. Even in those exhaust valves which have reduced "spitting", their valving mechanisms are mechanically complicated and susceptible to wear.

Finally, the backflow preventing valves of the prior art are generally bulky devices utilizing large intermediate chambers. The large intermediate chambers have been required because of the relatively large inlet and outlet check valves and exhaust valves used therewith. A more compact design for the check valves and exhaust valves would greatly contribute to reducing the bulkiness of the current backflow preventing designs. A backflow preventing valve utilizing a low-profile valve body could be used in many applications where mounting space tends to be a problem.

Accordingly, it is the principal object of the present invention to simplify the design of the check valve portions of a backflow preventing valve.

It is another object of this invention to control the manner in which the inlet and outlet passages of backflow preventing valves are closed.

It is still another object of this invention to rapidly and efficiently close the check valve portion of a backflow preventing valve.

It is yet another object of this invention to provide a more compact check valve and exhaust valve design for use in a backflow preventing valve.

It is a further object of this invention to provide a highly-durable check valve in a backflow preventing valve.

It is another object of this invention to reduce the spitting action of the exhaust valve portion of a backflow preventing valve by absorbing transitory fluid displacements from the intermediate chamber for large reductions in inlet pressure.

It is still another object of this invention to both simplify the design of the exhaust valve portion of a backflow preventing valve and to prevent the spitting from occurring.

It is a further object of this invention to provide a high-durable exhaust valve in a backflow preventing valve.

It is still another object of this invention to provide a low-profile backflow preventing valve applicable to a wide variety of uses.

It is yet another object of this invention to prevent the contamination of the supply fluid to which a backflow preventing valve is connected.

SUMMARY OF THE INVENTION

The present invention, in a broad aspect, provides an improved check valve for a backflow preventing valve of the type having a body with an inlet passage for connection to a source of fluid, an intermediate chamber fluidly connected to the inlet passage via one check valve, and an outlet passage fluidly connected to the intermediate chamber via a second check valve for connection to a receiver of fluid. The improved check valve includes a stationary valve port fluidly communi-

cating with the intermediate chamber, a movable contoured valve seat for sealing the valve port, and a valve closing apparatus in rolling engagement with the valve seat and responsive, in the inlet and outlet check valves, to the differences in the pressure of the fluid in the intermediate chamber and the fluid in the inlet and outlet passages. The valve closing apparatus urges the valve seat to a valve closed position against the valve port when the fluid pressure at the outlet passage increases relative to the fluid pressure at the intermediate chamber.

In accordance with one feature of the invention, the movable valve seat has a frustoconical outer surface providing camming contours for rolling engagement with the valve closing apparatus.

In accordance with still another feature of the invention, the valve closing apparatus includes a stationary shaft mounted to the backflow preventer body for sliding engagement with an axial cavity in the movable valve seat. A pair of rollers connected to a pair of arms attached to the backflow preventer valve body for arcuate movement in a plane parallel with the shaft, are positioned upon the contoured outer portion of the valve seat. A spring member, interconnecting the arms, biases the arms and thus the rollers against the contoured valve seat and thereby effects the closure of the seat member against the valve port.

In accordance with another feature of the invention, an improved exhaust valve, communicating with the inlet passage and with the intermediate chamber, resists the gating of fluid from the intermediate chamber to the atmosphere for only transient increases in the pressure of the fluid in the intermediate chamber relative to the pressure of the fluid in the inlet passage.

In accordance with a further feature of the invention, the improved exhaust valve includes a valve body communicating with the backflow preventer body and with the atmosphere, and provisions for sensing the intermediate chamber and inlet passage pressures. A movable diaphragm in separate sealing communication with the inlet passage and with the intermediate chamber moves in response to pressure changes of the fluids therein. A balanced valve member, resiliently biased between the movable diaphragm and a stationary seat in the valve body provides a path between the intermediate chamber and the atmosphere when in a valve open position. The resilient biasing of the valve member enables the exhaust valve to accommodate the fluid displacement changes that occur in the intermediate chamber as the result of large pressure reductions of the fluid in the inlet passage. The "spitting" associated with the prior art exhaust valves is thereby eliminated.

In accordance with another feature of the invention, the resilient biasing for the valve member utilizes a pair of springs disposed on either side thereof. The first spring is positioned between valve and the movable diaphragm. The second spring is positioned between the valve and the stationary seat. The second spring urges the valve member to a valve open position and thereby determines the differential pressure (between the fluids in the inlet passage and intermediate chamber) across the diaphragm at which the valve opens. The first spring transfers the differential pressure across the diaphragm to the valve member to close the valve and allows the diaphragm to move to absorb a certain amount of fluid displacement from the intermediate chamber as a result of transitory fluid pressure increases in the intermediate chamber. This arrangement absorbs differential pressure changes between the differential pressure at which the valve opens and the differential pressure normally occurring between the inlet passage and intermediate chamber when fluid is flowing through the backflow preventing valve.

In accordance with a final feature of the invention, the improved check valve and exhaust valve portions of the backflow preventing valve are of compact design, thereby providing the overall design of the backflow preventing valve with a low profile.

Other objects, features, and advantages of the present invention will become apparent from a consideration of the following detailed description and from the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a top plan view of an improved backflow preventing valve according to the present invention;

FIG. 2 shows a cross-sectional view of the backflow preventing valve of FIG. 1, taken through the plane II—II;

FIG. 3 shows an enlarged view of the inlet and oulet check valve portions of the backflow preventing valve shown in FIG. 2, with the check valves in a valve closed position;

FIG. 4 shows an enlarged view of the inlet and outlet check valve portions of the backflow preventing valve shown in FIG. 2, with the check valves in a valve open position; and

FIG. 5 shows a cross-sectional view of the exhaust valve portion of the backflow preventing valve of FIG. 1, taken through the plane V—V.

DETAILED DESCRIPTION

Referring now to the drawings and particularly to FIGS. 1 and 2, the preferred exemplary embodiment of an improved backflow preventing valve according to the present invention is generally denoted **10**. The valve **10** is for installation in an irrigation or other fluid-oriented system having a source of fluid and a receiver for fluid which are to be kept separate except when there are suitable pressures to cause flow from the source to the receiver. The instant invention is an improvement of the backflow preventing valves described and claimed in my U.S. Pat. Nos. 3,724,487 and 4,080,980, and reference should be made thereto for examples of the uses for such a system.

Generally, the valve **10** includes a valve housing including a lower valve body **11**, an intermediate valve body **39**, an upper valve body **40**, a housing cap **124**, and an exhaust valve body **150**, all with holding means such as bolts **49**, **152** and **164** for holding the parts together. All of these parts may be secured together in any suitable manner with O-rings **38** provided, as shown, where necessary. As discussed in my prior patents, all of these components may comprise a plurality of molded parts.

Fluid from a source of fluid (not separately shown) enters the valve body **10** through an inlet passage **12** in the lower valve body **11**. The inlet passage **12** is coupled to an inlet **12a** from the source of fluid. From the inlet passage **12**, the fluid passes into an intermediate chamber **13** formed by the upper valve body **40** and housing cap **124**. The chamber **13** is fluidly connected to the inlet passage **12** via an inlet check valve **80**. From the intermediate chamber **13**, the fluid passes to an outlet passage **14**, which is fluidly connected to the intermediate chamber **13** by an outlet check valve **100** for connec-

tion to an outlet 11a leading to a receiver of fluid (not separately shown). The inlet passage 12 and the outlet passage 14 are both molded apertures in the lower housing body 11. Also, the inlet passage 12 and the outlet passage 14 are internally threaded as shown for receiving the inlet 12a and the outlet 11a therein.

The lower valve body 11 also forms the lower portion of a pair of ball valves 70 and 75, which are provided for controlling the fluid flow through the inlet passage 12 and the outlet passage 14, respectively. The lower valve body 11 may be similar to that described in my prior U.S. Pat. No. 3,724,487. The inlet ball valve 70 is mounted within a valve chamber 52 having therein a valve seal 53. The outlet ball valve 75 is mounted within a second valve chamber 57 having therein an outlet ball valve seal 58. The seals 53 and 58 permit the rotation of the ball valves 70 and 75 to place ball valve apertures 72 and 77 in respective alignment with the inlet passage 12 and the outlet passage 14. The intermediate body 39 includes a cylindrical side wall 41 with a peripheral flange 41a for abutting contact with the upper surface of part 11 for securement thereto in any suitable manner, such as gluing, bolting, etc, to retain the inlet and outlet ball valves 70 and 75 therebetween.

A handle 78, connected to the outer barrel valve 75 by a drive shaft 90, extends out of the housing body 40 and terminates in a transversely-extending outer handle portion as shown in FIG. 1. Both ball valves 70 and 75 are rotated in a similar fashion. The structure for rotating the ball 70 is not shown for convenience of illustration. Thus, the inlet ball 70 is rotatable via the handle 78 between an open position, wherein the aperture 72 is aligned with the inlet passage 11 and inlet check valve 80, and a closed position where no such alignment occurs. Similarly, the outlet ball valve 75 is rotatable between an open position, wherein the aperture 77 is aligned with the outlet passage 14, and a closed position. The fluid flow, which is manually controlled by the ball valves 70 and 75, is also automatically controlled against backflow by the check valves 80 and 100.

FIGS. 3 and 4 show, in detail, the construction of the inlet check valve 80 and the outlet check valve 100. FIG. 3 shows the check valves in a closed position, as would be the case when there is no fluid flow through the unit. FIG. 4 shows the inlet and outlet check valves 80 and 100 in an open position allowing fluid to pass from the inlet passage 12 through the intermediate chamber 13 and to the outlet passage 14.

Referring to FIG. 3, the inlet check valve 80 includes a raised cylindrical valve port 200 having a generally circular opening 202 at one end. The upper portion of the valve port 200 includes a square "O"-ring 204 to aid in the sealing of the inlet passage 12. Disposed adjacent the valve port 200 is a movable valve seat 206. The outer surface of valve seat 206 is generally frustoconical and includes a peripheral flange 208, a generally conical middle body portion 212 functioning as a camming surface, and a generally concave upper body portion 214. At the edge of the peripheral flange 208 is a sharp circular ridge 210 which is moved into abutting relation with square ring 204 when the inlet check valve 80 is in a closed position as shown in FIG. 3. Downwardly depending through the axial center of the valve seat 206 is an elongated cylindrical cavity 242.

It is to be noted that, while FIGS. 3 and 4 show the movable valve seat member 206 to be generally circular, the present invention could be practiced with a non-circular valve seat 206 having two inclined ramping surfaces 212 and 213 and two generally concave upper portions 214 and 215 symmetrically disposed on opposite sides of the movable valve seat 206.

The particular configuration of the movable seat 206 portion of the inlet check valve 80 is designed to cooperate with a valve closing mechanism rigidly affixed to the housing cap 124. As shown in FIG. 3, the valve closing mechanism includes a shaft member 240 positioned within the circular cavity 242 of the valve seat 206, a pair of arm members 230 and 232 rotatably attached via pins 238 and 236 to a bar member 234 attached to the housing cap by screws 246 and 244. The arm members 230 and 232 are rotatably attached to the bar member 234 for coplanar arcuate movement on opposite sides of the shaft 240. The arm members 230 and 232 are urged toward the shaft 240 by means of a spring member 228 mounted therebetween upon pins 224 and 226.

Rolling engagement between the arm members 230 and 232 and the movable seat 206 is made with two cam rollers 222 and 216 mounted via axles 220 and 218 to the arm members 230 and 232. These rollers 216 and 222 may be mounted, by teflon bearings or the like, to the shafts 218 and 220, which themselves may be of a relatively small diameter. These rollers 216 and 222 transfer the biasing force of the spring member 228 to the movable seat 206 to urge it to a closed position against the valve port 200 when the pressure in the intermediate chamber 13 is greater than that in the inlet passage 12. Concerning the relatively small diameter of the shafts 218 and 220 supporting the rollers 216 and 222, the shafts may be as small as ⅛ inch for a valve opening 200 approximately 6 inches in diameter and may be approximately 1/32 inch in diameter for a one-inch valve opening.

As shown in FIG. 4, when the pressure of the fluid in the inlet passage 12 is greater than that in the intermediate chamber 13 plus the biasing force of the spring member 228, the valve seat 206 is urged upwardly on the shaft 240 by the inlet fluid pressure until the rollers 216 and 222 are at the bottom end of the outer conical section 212 of the valve seat 206, whereupon fluid flows freely through the check valve 80. As the pressure of the fluid in the inlet passage 12 decreases relative to that in the intermediate chamber 13, the spring member 228 urges the valve seat 206 toward the valve port 200 by means of the rollers 216 and 222 traveling on the conical section 212 of the valve seat. The seat 206 thereby reaches a valve closed position against the part 200 and fluid flow through the check valve 80 ceases. The flow of fluid through the check valve 80 thus opens and closes the valve.

When the valve seat 206 is fully closed against the valve port 200, the rollers 216 and 222 are positioned in a flattened area 214' of the concave upper portion 214 of the valve seat 206. This flattened area 214' increases the closing force and the pressure differential when the check valve is in a low-flow position. The change in the outer slope of the conical section 212 of the seat 206 to a more flattened section 214' in the concave area 214 also provides an initial opening resistance for the valve seat 206, thereby insuring that the pressure of the fluid in the inlet passage 12 is definitely greater than the fluid in the intermediate chamber 13 prior to the opening of the valve.

When the valve is in a closed position with the rollers 216 and 222 on the flattened area 214' 206, an opening force of approximately 6 pounds per square inch with

the appropriate spring tension 228 can be required. Once the valve has opened, and the rollers are on the conical portion 212 of the valve seat 206, the required opening force can drop to approximately 3 pounds per square inch. When the rollers have reached the peripheral flange 208, the opening force is approximately 2 pounds per square inch.

The upper portion of concave upper surface 214 also provides a stop for the rollers 216 and 222 when the check valve is removed from the unit. When the check valve is assembled in the backflow preventing unit, the rollers 216 and 222 are then resting on the flattened section 214', and are clear of the upper portion of the concave area 214.

As can be appreciated from the foregoing, the improved check valve of the present invention is a extremely compact unit utilizing only a limited number of moving parts. The check valves found in the prior art generally use a circular piston member supporting an axial spring which urges the piston member to a valve closed position. As such, the assembly containing the piston and its accompanying spring member tends to be rather lengthy and thereby obviates any possibility for compact installation. In addition to providing a compact design, the improved check valve of the present invention insures a much lower pressure loss through the unit at high flow rates than do the piston-type check valves of the prior art.

The outlet check valve 100 is almost identical in construction to the inlet check valve 80 and thus the same structure appears in each and the description of one valve is the same as that for the other. As shown in FIGS. 3 and 4, the outlet check valve 100 includes a valve port 300 containing a valve opening 302 therein and supporting an O-ring 304. Disposed adjacent the valve port 300 for abutting engagement therewith is a movable valve seat 306 supported on a shaft 340 fixedly mounted to the apparatus. As discussed previously, the valve seat 306 includes a peripheral flange 308 having molded thereon a ridge 310 for engagement with the square "O"-ring 304. The valve seat 306 includes a conical camming surface 312 adjacent the peripheral flange 308 and terminating in a concave section 314.

The valve seat 306 is urged against the valve port 300 by a valve-closing mechanism 390 including the shaft 340, a pair of arm members 330 and 332 attached by pins 336 and 338 to a bar 334 connected to the upper body 340 by means of screws 346 and 344. The arms 330 and 332 are disposed for arcuate movements on opposite sides of the shaft 340 and support a spring member 328 by means of pins 324 and 326. The arms 332 and 330 also support, via axles 320 and 318, a pair of rollers 316 and 322.

The rollers 316 and 322 engage the conical portion 312 of the valve seat 306 and transfer the biasing force of the spring member 328 to the valve seat 306. As such, the conical surface 312 acts as a cam and the rollers 316 and 322 function as cam rollers in urging the valve seat 302 against the valve port 300 when the pressure in the intermediate chamber 13 is less than the pressure in the outlet passage 14 plus the biasing force of the spring member 328. As such, the outlet check valve 100, like the inlet check valve 80, is responsive to the pressure differential between the intermediate chamber 13 and the appropriate inlet or outlet passage 12 and 14. Therefore, the flow or volume of fluid flowing through the outlet check valve 100 determines the position of the check valve.

The outlet check valve 100, like the inlet check valve 80, is of a compact design because of the novel arrangement of the valve seat 306 and the valve closing apparatus 390, by which the valve seat 306 moves upon the shaft portion 340 of the valve closing mechanism 390 and is urged to a closed position against the valve port 300 by the camming action provided by the rolling engagement between the rollers 316 and 322 and the conical section 312 of the valve seat 306.

The novel inlet and outlet check valves 80 and 100 used in the present invention allow the housing cap 124 a portion of the backflow preventing valve 10 to have an extremely low profile, thereby reducing the size of the intermediate chamber 13 and allowing use of the valve 10 in applications where space is at a premium. The improved backflow preventing valve of the present invention is approximately two-thirds of the height of the backflow preventing valve in my prior U.S. Pat. No. 4,080,980 and other similar backflow preventers.

The novel features of the improved backflow preventing valve of the present invention are also provided by the exhaust valve 150 attached to the apparatus. As shown in FIGS. 1 and 5, the exhaust valve 150 is attached to the upper body 40 portion of the backflow preventing valve 10 via screws 152 or similar fastening means. The exhaust valve 150 includes a 3-part body including a lower body 154 communicating with the atmosphere, an intermediate body 156 communicating with the lower body and with the intermediate chamber 13, and an upper body 158 communicating with the intermediate body 156 and with the inlet passage 12. The lower body 154, intermediate body 156, and upper body 158 may be held together by any suitable means such as by thru-bolts 192, and O-rings may be provided for maintaining appropriate seals therebetween.

FIG. 5 shows a cross-sectional view of the novel exhaust valve 150. The exhaust valve 150 communicates with the inlet passage 12 via a nozzle 186 passing through the wall of the cylindrical valve port 200 portion of the inlet check valve 80. The nozzle 186 is sealed from the intermediate chamber 13 by O-rings 187 or the like. The nozzle 186 communicates between the inlet passage 12 and the upper side of a movable rigid diaphragm 178 in the upper housing 158 portion of the exhaust valve 150. In a similar fashion, communication is made between the intermediate chamber 13 and the lower side of the diaphragm 178 via a port 188 in the upper body portion 40 of the backflow preventer.

Movable diaphragm 178 rides in a cylindrical cavity 190 formed by the upper body 158 and intermediate body 156 portion of the exhaust valve. Attached to the intermediate body 156 and to the top and side portions of the movable rigid diaphragm 178 is a resilient circular diaphragm 180. The resilient diaphragm 180 maintains the inlet passage fluid on the upper side of the solid diaphragm 178 separate from the intermediate chamber fluid on the lower side of the movable diaphragm 178.

As so configured, the rigid diaphragm 178 with its resilient outer member 180 provides a means for comparing the pressure of the fluid in the inlet passage 12 with that in the intermediate chamber 13. As shown in FIG. 5, when the inlet passage pressure is greater than the intermediate chamber pressure, the movable diaphragm 178 moves downwardly in the cylindrical cavity 190. Conversely, when the pressure of the fluid in the intermediate chamber 13 is equal to that in the inlet passage 12, the movable diaphragm 178 moves upwardly in the cylindrical passage 190.

Disposed between the diaphragm **178** and a stationary valve seat **160** with a resilient seating surface **170** attached to the lower body **154** of the exhaust valve **150** is a circular balanced valve member **162**. As shown in FIG. **5**, the balanced valve member **162** is movable between a valve open and a valve closed position relative to the stationary valve seat **160**. A resilient annular diaphragm **166** connects the balanced valve **162** to the lower body **154** for movement therein. In this manner, when the balanced valve is in a valve closed position against the valve seat **160**, as shown by the dashed lines in FIG. **5**, the fluid in the exhaust valve is prevented from passing to the atmosphere through the lower body **154**. The balanced valve **162** moves away from the valve seat **160** as the pressure of the fluid in the intermediate chamber **13** increases relative to the pressure of the fluid in the inlet passage **12**.

The novel features of the exhaust valve **150**, which provide a greatly increased resistance to transient increases in the pressure of the fluid in the intermediate chamber relative to that in the inlet passage, result from the arrangement of the balanced valve **162** and the movable diaphragm **178**. In this regard, the diaphragm **178** communicates with the valve **162** by means of a first spring member **176** positioned between an inner flange **182** on the diaphragm **178** and an upper inner flange **174** on the valve **162**. Positioned between the stationary valve seat **160** and a lower inner flange **172** is a second spring member **164**.

The first spring member **176** resiliently couples the downward movement of the diaphragm **178**, occurring as a result of the inlet passage pressure being greater than the intermediate chamber pressure, to the balanced valve **162** to urge the valve **162** against the valve seat **160** to a valve closed position, thereby preventing passage of the fluid in the intermediate chamber **13** to the atmosphere. By contrast, the second spring **164** urges the valve member **162** to a valve open position in opposition to the downward force of the movable diaphragm **178**, as transferred to the valve **162** by the first spring **176**. In this manner, when the pressure of the fluid in the inlet passage is greater than the pressure of the fluid in the intermediate chamber, the diaphragm **178** will be urged downwardly by the inlet passage pressure by a sufficient degree to move the valve **162** to a closed position against the resilient portion **170** of the stationary seat **160**, thereby preventing the passage of fluid from the intermediate chamber **13** to the atmosphere through the lower body **154**.

In a similar manner, when the pressure of the fluid in the intermediate chamber is approximately equal to that of the fluid in the inlet passage, the diaphragm **178** will be moved upwardly by the intermediate passage pressure to an extent whereby the valve **162** is moved by the lower spring **164** away from the stationary seat **160**. This opens the intermediate chamber to the atmosphere and exhausts the fluid from the intermediate chamber until the pressure therein drops to a value less than the inlet passage pressure.

The arrangement of the balanced valve **162** and the upper and lower springs **176** and **164** resist the opening of the exhaust valve for only brief changes in the pressure of the intermediate chamber relative to that in the inlet passage. That is, the cooperation between the two spring members **176** and **164** provides a force-absorbing mechanism that causes the diaphragm **178** to move up and down in its cylindrical cavity **190** for only brief changes in the intermediate chamber pressure, without causing the opening of the balanced valve member **162**.

The novel arrangement of the exhaust valve not only provides an increased resistance to "spitting" action, but also provides a much more compact design than was previously available in the exhaust valves found in the prior art. The exhaust valve of the present invention would function as a prior art exhaust valve without the first spring **176** and with the movable diaphragm **178** connected directly to the valve **162**. Such an arrangement would be subject to "spitting" caused by fluctuations in the line pressure feeding the backflow device. If, for example, the pressure was fluctuating between 40 and 100 psi, when the pressure rose to 100 psi, the pressure in the intermediate chamber would follow this increase and rise to 94 to 96 psi. The downstream pressure would, of course, also rise. When the upstream or supply pressure receded back to the 40 psi level, the outlet check valve would close and prevent water from moving from the outlet passage into the intermediate chamber. However, as the outlet check valve closed, a large pressure differential would be developed across the outlet check valve forcing it tightly against its seat. As a result, there would be a displacement of water into the intermediate chamber. This would cause the intermediate chamber pressure to rise (because the inlet check valve would already be closed).

As the supply pressure increased back to 50 psi, the intermediate chamber pressure would have to fall because the intermediate chamber pressure is always below the inlet passage pressure due to the relative size of the inlet passage and intermediate chamber. The intermediate chamber pressure would have to fall to 44–46 psi. For this to occur, water would have to be forced from the intermediate chamber to the exhaust valve. Thus, the spitting action would result from the lifting of the valve member **162** in response to a displacement of water from the intermediate chamber. This undesireable "spitting" is eliminated with the present invention.

With the resilient connection between the movable diaphragm **178** and the valve member **162**, the diaphragm may move upwardly to accommodate the water needed to lower the pressure in the intermediate chamber, without allowing the valve member **168** to loose contact with its seat **160**, thereby preventing the "spitting" action. The normal difference in pressure between the inlet fluid pressure and the intermediate chamber fluid pressure is approximately 6 psi. When this pressure falls to 3 psi, the valve member will start to lift from the seat. If the first spring **176** is of proper force and resilience, the diaphragm **178** can move upwardly a considerable amount before the pressure changes from the normal 6 pounds differential to the 3 pounds differential at which the relief valve opens. This movement of the diaphragm allows the system to accommodate changes in displacement that are generated by line pressure fluctuation without having to vent this water to the atmosphere.

As is the case with the other components of the present invention, the upper, intermediate, and lower exhaust valve body members, as well as the movable diaphragm **178** in the balanced valve **162** may be made of molded plastic parts or the like. The compact design of the exhaust valve **150**, when combined with the compact design of the inlet and outlet check valves **80** and **100**, provides the backflow preventing apparatus of the

present invention with an extremely low profile, as well as with an extremely attractive and efficient design.

In the foregoing description of the present invention, a preferred embodiment of the invention has been disclosed. It is to be understood that other mechanical and design variations are within the scope of the present invention. Thus, by way of example and not of limitation, the movable check valve seats could have outer contours differently than described to provide the same camming action between the valve seat and the roller portion of the valve closing mechanism; the valve closing mechanism itself could utilize rollers disposed differently on the movable valve seat; only one roller, attached via a spring to the housing, could be utilized in the valve closing mechanisms; the valve port portions of the check valve could be configured differently than described; different means could be utilized in the exhaust valve to resiliently bias the valve member between open and closed positions; means other than a movable diaphragm in the exhaust valve could be utilized to compare the pressure in the inlet passage with the pressure in the outlet passage; means other than a nozzle could be utilized to sense the pressure of the fluid in the inlet passage; and the movable diaphragm and cylindrical valve members could be configured directly to achieve the desired results. Accordingly, the invention is not limited to the particular arrangement which has been illustrated and described in detail.

What is claimed is:

1. An improved check valve for a backflow preventing valve of the type having a body with an inlet passage for connection to a source of fluid, an intermediate chamber fluidly connected to said inlet passage via a first check valve, and an outlet passage fluidly connected to said intermediate chamber via a second check valve for connection to a receiver of fluid, said check valve comprising:
- stationary valve port means fluidly communicating with said intermediate chamber;
- movable valve seat means for sealing said valve port means, said seat means including ramp means having both inclined and concave ramping surfaces for providing a progressively decreasing opening force as said seat means moves from a valve closed to a valve open position relative to said port means; and
- valve closing means, for urging said seat means to said valve closed position when the fluid pressure in said outlet increases relative to the fluid pressure in said intermediate chamber, said valve closing means being in rolling engagement with said concave ramping surface when said seat means is in said valve closed position and in engagement with said inclined ramping surface when said seat means moves toward said valve open position, whereby said opening force is greater when said closing means engages said concave ramping surface than when said closing means engages said inclined ramping surface, said closing means including stationary shaft means upon which said seat means moves.

2. An improved check valve as defined in claim 1, wherein said valve port means comprises:
- a cylindrical valve opening in said body; and
- sealing ring means for engagement with said seat means.

3. An improved check valve as defined in claim 2, wherein said valve seat means includes:
- ridge means for engaging said sealing ring means when said seat means is in a valve-closed position against said valve port means.

4. An improved check valve as defined in claim 1, wherein said seat means comprises:
- a valve seat having a generally frustoconical surface with an annular recess at one end of said surface, said frustoconical surface comprising said inclined ramping surface and said annular recess comprising said concave ramping surface; and
- axial cavity means for receiving said shaft means, whereby said check valve opens and closes in response to said pressure differential by sliding along said shaft means under urging from said valve closing means.

5. An improved check valve as defined in claim 1, wherein said valve closing means comprises:
- stationary shaft means mounted to said body for sliding engagement with said seat means;
- roller means for contacting said ramping surface on said seat means;
- arm means, operatively connected to said body for arcuate movement in a plane parallel with said shaft means, for positioning said roller means against said ramping surfaces; and
- spring means, interconnecting said arm means, for biasing said arm means, and thus said roller means, against said ramping surfaces, whereby:
- (i) said seat means is moved to a valve open position by the fluid flowing through said check valve when the fluid pressure on the fluid source side of said seat means is greater than the pressure on the fluid receiver side of said seat means plus the biasing force of said spring means, and
- (ii) said seat means is moved to a valve closed position by said spring means, coacting with said roller means, when the flow of fluid through said check valve terminates.

6. An improved check valve as defined in claim 1, wherein:
- said inlet and outlet check valves are disposed within said intermediate chamber, thereby providing said backflow preventer body with a low profile.

7. In a backflow preventing valve having a body with an inlet passage for connection to a source of fluid, an intermediate chamber fluidly connected to said inlet passage via an inlet check valve, an outlet passage fluidly connected to said intermediate chamber via an outlet check valve for connection to a receiver of fluid, an exhaust valve connected to said inlet passage and to said intermediate chamber which vents fluid in said intermediate chamber to the atmosphere when the pressure of fluid in said intermediate chamber is equal to the pressure of said fluid in said inlet passage, the improvement in each check valve comprising:
- valve port means;
- valve seat means for movement between open and closed positions relative to said port means, said seat means including a frustoconical surface and an axial cavity;
- valve closing means, for urging said seat member to a valve closed position, said closing means including:
- stationary shaft means for sliding engagement with said axial cavity;
- roller means for rolling engagement with said frustoconical surface;
- arm means, for positioning said roller means against said seat means; and

spring means for biasing said roller means against said frustoconical surface, whereby:

(i) said outlet check valve seat means is urged to said valve closed position by said outlet valve spring means when the fluid pressure in said intermediate chamber is less than the fluid pressure in said outlet passage plus the biasing force provided by said outlet valve spring means and applied to said seat means by said roller means, and

(ii) said inlet valve seat means is urged to said valve closed position by said inlet check valve spring means when the fluid pressure in said inlet passage is less than the fluid pressure in said intermediate chamber plus the biasing force of said inlet check valve spring means.

8. In a backflow preventing valve having a body with an inlet passage for connection to a source of fluid, and an intermediate chamber fluidly connected to said inlet passage, an exhaust valve connected to said inlet passage and to said intermediate chamber which vents fluid in said intermediate chamber to the atmosphere when the pressure of fluid in said intermediate chamber is equal to the pressure of said fluid in said inlet passage, said exhaust valve comprising:

a valve body communicating with said intermediate chamber and with said atmosphere;

means for sensing the fluid pressure in said inlet passage;

means for sensing the fluid pressure in said intermediate chamber;

means, communicating with both of said sensing means, for comparing the fluid pressures in said inlet passage and displacement from said intermediate chamber resulting from large reductions in said inlet passage pressure; and

balanced valve means, movably mounted to said valve body and resiliently coupled to said comparing means, for providing an opening from said intermediate chamber to said atmosphere only when said intermediate chamber fluid pressure is equal to said inlet passage fluid gressure, whereby said comparing means maintains said valve means in a valve closed position during said reductions in said inlet passage pressure.

9. A backflow preventing valve as defined in claim 8, wherein said comparing means comprises:

movable diaphragm means, in sealing communication with said inlet passage and with said intermediate chamber and resiliently coupled to said balanced valve means, for urging said valve means to a valve closed position when said inlet passage pressure is greater than said intermediate chamber pressure, and for allowing said valve means to open when said intermediate chamber pressure is equal to said inlet passage pressure.

10. A backflow preventing valve as defined in claim 9, wherein said balanced valve means comprises:

moveable valve means;

first biasing means, positioned between said diaphragm means and said valve means, for transferring the valve closing force of said diaphragm means to said valve means and for allowing said diaphragm means to move away from said valve means to absorb said fluid displacement while maintaining said valve closing force on said valve means; and

second biasing means, positioned between said valve means and said valve body, for urging said valve means to a valve open position when said intermediate chamber pressure is equal to said inlet passage pressure and for resisting said valve closing force of said diaphragm means, whereby said valve means is movably and resiliently positioned between said first and second biasing means, with the ratio of the resiliencies of said first and second biasing means determining the amount of said fluid displacement said diaphragm means can absorb and yet urge said valve means to said valve closed position, thereby preventing said opening for only transient fluxuations in said inlet passage pressure.

11. A backflow preventing valve as defined in claim 9, wherein:

said means for sensing said inlet pressure comprises nozzle means in sealing communication between said inlet passage and with one side of said diaphragm means; and

said means for sensing said intermediate chamber pressure comprises port means in sealing communication with said intermediate chamber and with the other side of said diaphragm means.

12. A backflow preventing valve as defined in claim 10, wherein:

(a) said diaphragm means comprises:

(i) a rigid diaphragm communicating on opposite sides with said nozzle means and with said port means, and

(ii) a resilient diaphragm attached between said valve body and said diaphragm, whereby said resilient diaphragm allows said rigid diaphragm to freely move in said valve body in response to the difference in pressure of the fluid in said inlet passage and the fluid in said intermediate chamber;

(b) said balanced valve means comprises:

(i) a valve seat rigidly attached to said valve body,

(ii) a hollow valve member movable against said valve seat to said closed position, and

(iii) a resilient annular diaphragm connected between said valve body and said hollow valve member;

(c) said first biasing means comprises a first spring member disposed between said rigid diaphragm and said hollow valve member;

(d) said second biasing means comprises a second spring member disposed between said hollow valve member and said valve seat, whereby until the pressure differential between said inlet passage pressure and said intermediate chamber pressure equals the valve opening force provided by said first spring member, said rigid diaphragm may move away from said hollow valve member to absorb said displacement, and yet maintain said hollow valve member in a valve closed position, thereby resisting the opening of said exhaust valve for only brief changes in said said inlet passage pressure.

13. An exhaust valve for a backflow preventing valve having a body with an inlet passage for connection to a source of fluid, and an intermediate chamber fluidly connected to the inlet passage, said exhaust valve being connected to said inlet passage and to said intermediate chamber to vent fluid in said intermediate chamber to the atmosphere when the pressure of the fluid in said intermediate chamber is greater than the pressure of said fluid in said inlet passage, said exhaust valve resist-

ing said venting of said fluid for transitory flucuations in said inlet passage pressure and comprising:

valve body means including a diaphragm cavity communicating with said inlet passage and with said intermediate chamber and an exhaust port communicating with the atmosphere;

diaphragm means, resiliently attached to said valve body means for movement within said diaphragm cavity and having diaphragm portions separately communicating with said inlet passage and with said intermediate chamber;

means, resiliently attached to said body means for opening said exhaust port to the atmosphere; and

biasing means, positioned between said diaphragm means and said opening means and between said opening means and said valve body means, for supporting said opening means in a balanced manner, whereby:

(i) as said inlet passage pressure increases, said diaphragm means moves toward said opening means and said biasing means resiliently transfers said movement to said opening means to position said opening means to close said exhaust port, and

(ii) as said intermediate chamber pressure increases, said diaphragm means moves away from said opening means, thereby allowing said biasing means to position said opening means to open said exhaust port, said biasing means resiliently resisting said opening of said exhaust port for transistory changes in said inlet passage pressure.

14. An improved backflow preventing valve as defined in claim 13, wherein said biasing means comprises:

first spring means, positioned between said diaphragm means and said opening means, for transferring said movement of said diaphragm means to said opening means and for allowing said diaphragm means to move away from said opening means to absorb transitory increases in the volume of fluid in said intermediate chamber; and

second spring means, positioned between said opening means and said valve body means, for urging said opening means to open said exhaust port, whereby:

(i) when said inlet passage pressure is greater than said intermediate chamber pressure, said opening means is moved to close said exhaust port, and

(ii) when said intermediate chamber pressure is equal to said inlet pressure, said opening means is moved to open said exhaust port, with said springs and diaphragm means resisting the opening of said exhaust port for brief reductions in said inlet passage pressure by absorbing said increase in the volume of fluid in said intermediate chamber produced by said reductions.

15. A backflow preventing valve as defined in claim 14, wherein:

(a) said exhaust valve further comprises:

(i) nozzle means, communicating with said inlet passage and said diaphragm cavity, for transferring said inlet passage pressure to one side of said diaphragm means, and

(ii) port means communicating with said intermediate chamber and with said diaphragm means, for transferring said intermediate chamber pressure to the other side of said diaphragm means;

(b) said diaphragm means comprises a generally cylindrical member sealingly communicating at its outer portion with said inlet passage pressure transferred through said nozzle means and sealingly communicating at its inner portion with said intermediate chamber pressure transferred by said port means, said cylindrical member including an annular flange for receiving one end of said first spring means and further including a resilient annular diaphragm attached to said diaphragm cavity for allowing said movement in said cavity and for maintaining said seal between said inlet passage pressure and said intermediate chamber pressure; and

(c) said opening means comprises:

(i) a generally hollow cylindrical valve member having annular flanges for receiving said the other end of first spring means and one end of said second spring means,

(ii) a resilient annular diaphragm attaching said cylindrical member to said valve body means for balanced linear movement in said body means to open and close said exhaust port, and

(iii) a stationary valve seat rigidly attached to said body means for receiving the other end of said second spring means and for receiving said cylindrical member to close said exhaust port.

* * * * *

United States Patent [19]

Beukema

[11] **4,408,788**

[45] **Oct. 11, 1983**

[54] **HINGEABLE SPLIT PIPE COLLAR**

[75] Inventor: **John A. Beukema**, Whitinsville, Mass.

[73] Assignee: **Grinnell Fire Protection Systems Company, Inc.**, Cranston, R.I.

[21] Appl. No.: **305,030**

[22] Filed: **Sep. 23, 1981**

[51] **Int. Cl.**^{3} **F16L 21/06**

[52] **U.S. Cl.** **285/419**; 285/112; 285/367

[58] **Field of Search** 285/112, 373, 419, 367, 285/325, 409

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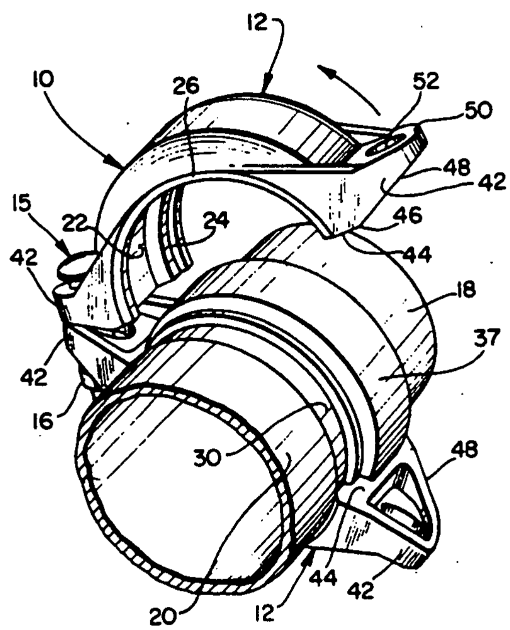
Primary Examiner—Dave W. Arola
Attorney, Agent, or Firm—Salter & Michaelson

[57] **ABSTRACT**

A split collar for use with pipe and the like including a pair of discrete semicircular collar halves each having outwardly extending flanges at their terminal ends, and which halves cooperate to define an essentially circular opening. The inner surfaces of adjacent flanges abut along their inboard portions and then generally diverge. Aligned holes of elongated configuration are provided in the flanges to permit securing of the halves together in assembled relation with bolt and nut combinations or the like. The point where the inner surfaces of adjacent flanges commence to diverge is inboard of the inner edges of the bolt head and nut; and, as a result, the halves may be swung to a substantially open position after removal of one of the bolts only and without any loosening of the other bolt.

5 Claims, 8 Drawing Figures



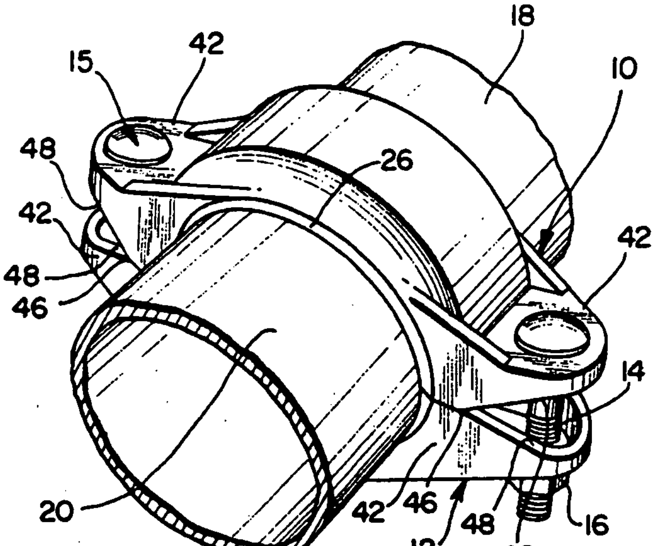
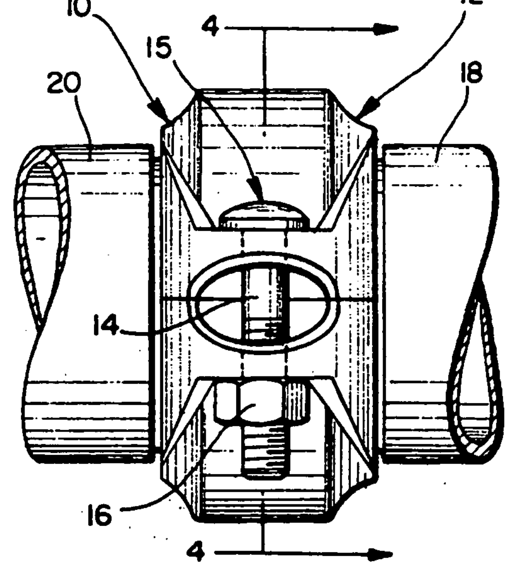


FIG. 1

FIG. 3



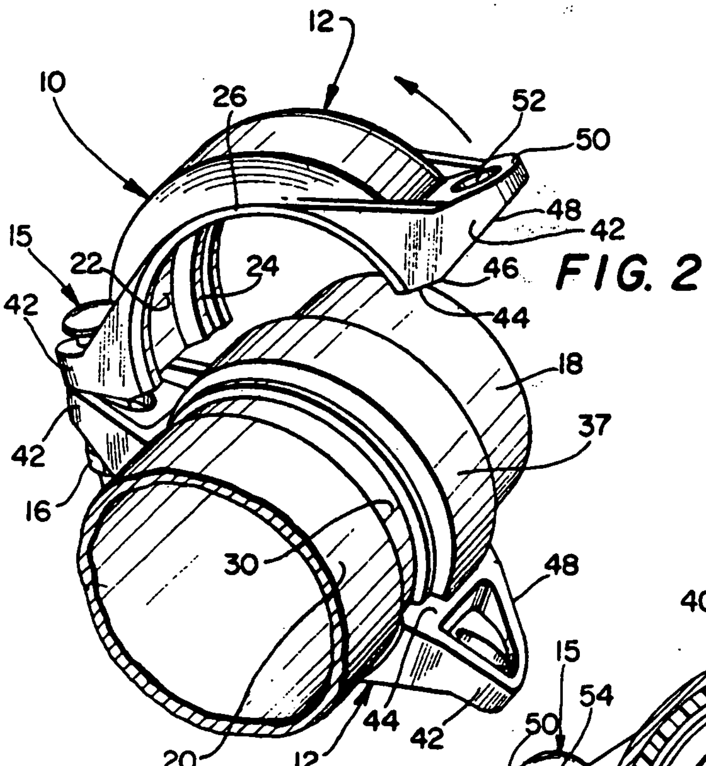


FIG. 2

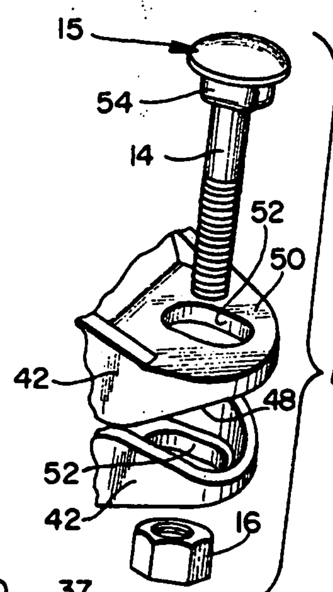


FIG. 5

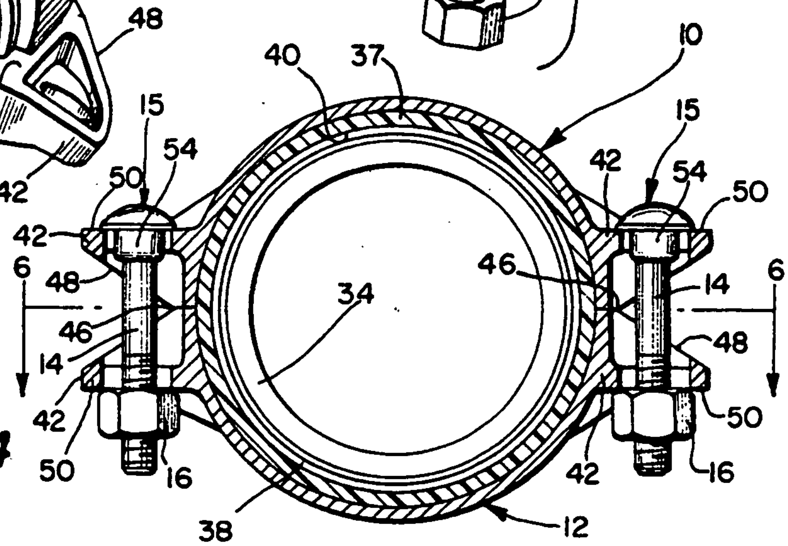
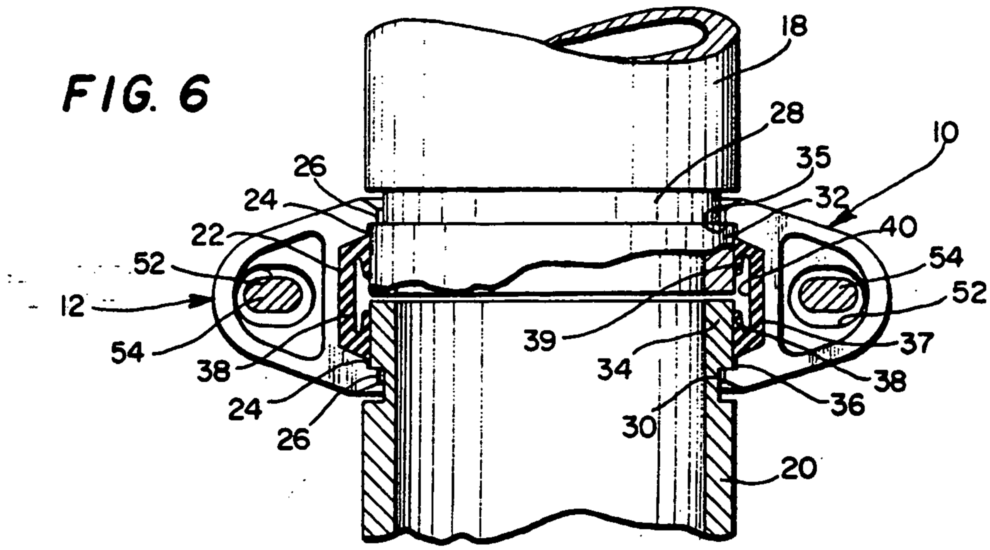


FIG. 4

FIG. 6



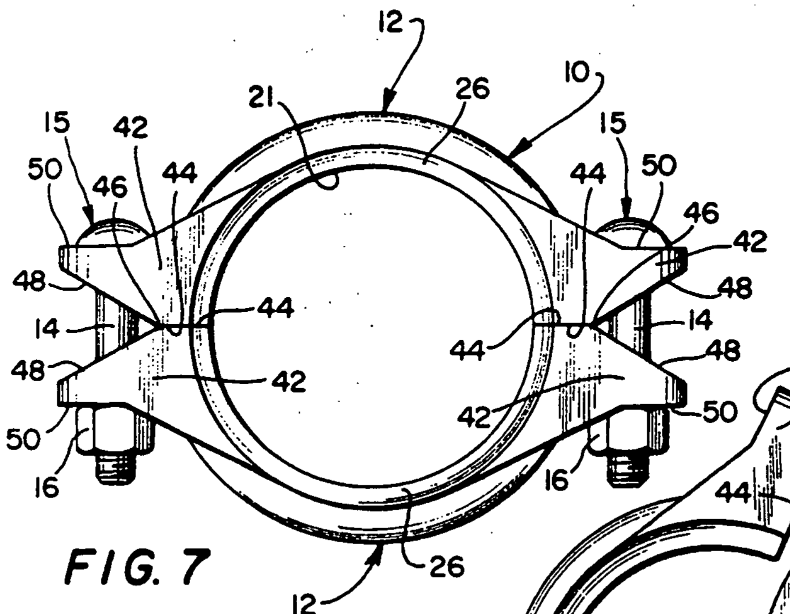


FIG. 7

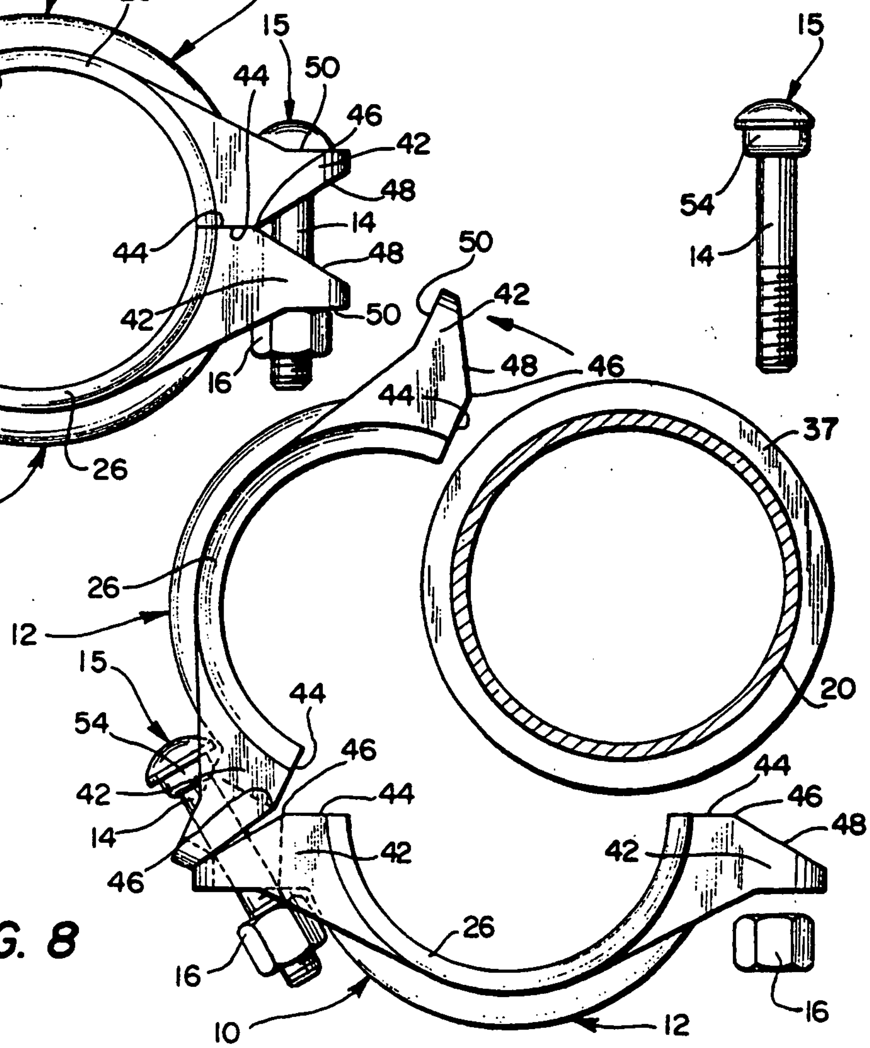


FIG. 8

HINGEABLE SPLIT PIPE COLLAR

BACKGROUND OF THE INVENTION

The instant invention relates to a split collar for use with pipe and the like and more particularly to a novel split collar which is installable on or removable from a position of engagement with one or a pair of pipe sections simply by removing a single nut and bolt combination used to secure the halves together.

Split collars for use with pipe and the like have heretofore been available in various configurations for a number of applications. One of the primary applications for split collars has been as couplings to secure the ends of pairs of pipe sections together. Couplings of this type have generally included an inner channel on the arcuate inner surface thereof which is engageable with the grooved ends of a pair of pipe sections to thereby secure the sections together. In most instances couplings of this type have been used in combination with ring-like elastomeric gaskets which are positionable within the coupling around the adjoining ends of the pipe sections to seal said ends as the gasket is compressed by the coupling. The couplings heretofore available have primarily been of two general types, i.e., hingeable couplings comprising a pair of coupling halves which are permanently secured together in a hingeable manner, and non-hingeable couplings comprising a pair of discrete couplings halves which are detachably secured together at their ends usually with a pair of threaded nuts and bolts. Hingeable couplings are in most cases more convenient to use since they generally require manipulation of only a single nut and bolt to secure them to or remove them from a pair of pipe ends, but they are frequently rather expensive as a result of their complex hinging mechanisms. Further, they can only be opened from one side since they are permanently secured together. On the other hand, non-hingeable type couplings are relatively inexpensive but are somewhat less convenient to use than hingeable couplings. In some instances, the inconvenience of using a non-hingeable coupling may be relatively insigificant involving only a few additional manipulative steps. However, in other instances, such as when working in confined areas, the inconvenience of using such couplings may involve substantial amounts of unnecessary work. The instant invention is directed to a split collar or coupling for use with pipe and the like wherein the advantages of non-hingeable and hingeable couplings are combined to provide a coupling which is both relatively inexpensive and convenient to use.

Couplings representing the closest prior art of which the applicant is aware are illustrated in the U.S. patents to NEWEL, No. 2,377,510; STILLWAGON, No. 2,449,795; BOWNE, No. 3,006,663; and PIATEK, No. 3,054,629. These couplings generally fit into one of the two categories of couplings described, hingeable or non-hingeable. The instant invention is directed to a novel split collar which combines the advantage of the previously known split collars and couplings comprising a pair of relatively inexpensive discrete coupling halves, which are nevertheless hingeable.

SUMMARY OF THE INVENTION

The instant invention comprises a pair of collar halves which are secured together at their terminal ends with nut and bolt combinations or the like but are nevertheless hingeable relative to each other upon removal of only one of said nut and bolt combinations. The collar halves may be relatively inexpensively made by casting in a substantially semi-circular configuration and together they cooperate to define an essentially circular opening for receiving a section of pipe or the adjoining ends of a pair of pipe sections. Flanges are provided on each of the ends of the halves and aligned bolt holes are provided in the flanges to secure the halves together with nuts and bolts. The inner surfaces of adjacent flanges abut for a distance and then diverge outwardly with respect to each other to define included angles of 50° or more. The bolt holes in the flanges are of elongated configuration and are oriented so that the elongated dimensions thereof extend generally outwardly from the circular opening. In addition, the point where the inner abutting surfaces commence to diverge is at least as close to the circular opening as the inboard edges of the bolt heads or the nuts (closeness of the respective head or nut to the circular opening being defined by the perpendicular projection of the head or nut into the plane of the adjacent abutting surface rather then by a direct radial distance). As a result of the relationship between the bolt heads or the nuts and the divergent surfaces of the flanges, the collar halves are hingeable relative to each other upon removal of only one of the fastening bolt and nut combinations without having to loosen the other bolt and nut combination. When one of the bolt and nut combinations is removed, the collar halves are free to pivot on a fulcrum which is substantially at the point where the inner surfaces of the still connected adjacent flanges commence to outwardly diverge and since the bolt holes are of elongated section, the necessary clearance is provided so that the collar halves may hingedly move without binding on the unloosened bolt shank.

As a result of the relatively simple configuration of the collar halves, they may easily be cast of suitable materials and do not require machining prior to use. Consequently, the coupling of the instant invention can be manufactured substantially more economically than the hingeable couplings previously known. In light of this, the coupling of the instant invention represents a substantial improvement in the art which has significant commercial advantages over those couplings previously known.

It is therefore an object of the instant invention to provide a split collar for use with pipe or the like which includes a pair of discrete collar halves which are secured together with nut and bolt combinations at their terminal ends but which are hingeable relative to each other upon removal of one of said nut and bolt combinations.

Another object of the instant invention is to provide a hingeable split collar construction which is economical to manufacture.

Other objects, features and advantages of the invention shall become apparent as the description thereof proceeds when considered in connection with the accompanying illustrative drawings.

DESCRIPTION OF THE DRAWINGS

In the drawings which illustrate the best mode presently contemplated for carrying out the present invention:

FIG. 1 is a perspective view of a split collar made in accordance with the instant invention embodied as a

pipe coupling securing the adjoining ends of a pair of pipe sections together;

FIG. 2 illustrates the coupling of FIG. 1 in open position;

FIG. 3 is a side elevational view of the coupling-pipe assembly;

FIG. 4 is a section taken on line 4—4 of FIG. 3;

FIG. 5 is an exploded fragmentary perspective view of a pair of adjacent coupling flanges with one of the nut and bolt combinations used for securing the coupling halves together;

FIG. 6 is a section taken on line 6—6 of FIG. 4;

FIG. 7 is an elevational view of the coupling per se; and

FIG. 8 is an elevational view of the coupling in the open position illustrating the hinging of the two halves thereof to provide clearance for insertion over or removal from a section of pipe or the like with an elastomeric gasket positioned thereon.

DESCRIPTION OF THE INVENTION

Referring now to the drawings, the split collar of the instant invention embodied as a pipe coupling is illustrated generally at 10. As will be noted, the coupling 10 comprises a pair of opposed coupling halves generally indicated at 12 which are secured together in assembled relation with threaded bolts 14 having heads 15 and threaded nuts 16 whereby the halves 12 cooperate to adjoin the ends of a pair of pipe sections 18 and 20 together in abutting or slightly spaced relation.

The inner configuration of each of the halves 12 is substantially semicircular so that the halves 12 together in assembled relation define a substantially circular opening 21 for receiving the adjoining ends of the pipe sections 18 and 20.

As will be seen particularly from FIGS. 2 and 6, in order to adjoin the ends of the sections 18 and 20, circumferential channels 22 having circumferential shoulder portions 24 which culminate in circumferential key sections 26 are provided on the inner surfaces of the halves 12. Circumferential grooves 28 and 30 are provided on the pipe sections 18 and 20, respectively, spaced inwardly from their respective terminal ends and defining terminal rims 32 and 34 on said pipe sections. The sections 18 and 20 are secured together with key sections 26 engaging within the grooves 28 and 30 as at 35 and 36, respectively, to adjoin said sections 18 and 20 in slightly spaced or abutting relation. A ring-like gasket 37 made of a suitable flexible gasket material such as rubber or the like and having lips 38 and 39 which define a compressible inner channel 40 is mounted within the channel 22 in engagement with the rims 32 and 34. As the halves 12 are secured together, the gasket 37 is compressed between the channel 22 and the rims 32 and 34 to thereby provide the desired sealing between the sections 18 and 20. In actual operation fluid pressures within the channel 40 further effect this sealing by causing further pressurized engagement of the lips 38 and 39 with the rims 32 and 34.

Outwardly extending flanges 42 are provided at the terminal ends of each of the halves 12. As will be seen, the inboard portions of the inner surfaces of the flanges 42 form abutting surfaces 44 which extend substantially diametrically from the circular opening 21. The inner surfaces of the flanges 42 then commence to diverge at fulcrums 46 to form outwardly divergent surfaces 48. The outer surfaces 50 of the flanges 42 are substantially parallel to the abutting surfaces 44 with aligned bolt holes 52 of elongated configuration being provided in the flanges 42 to secure them together. As will be seen, the bolt holes 52 are oriented so that the elongated dimensions thereof extend generally outwardly from the circular opening 21. The halves 12 then are securable together in assembled relation with the bolts 14 extending through the holes 52 in adjacent flanges 42 and then being secured by the nuts 16. Preferably, the bolts 14 are "track" type bolts having oblong step shanks 54 which are receivable in the holes but it is understood that other suitable bolts or other fastening means could be used.

In order to allow the two halves 12 to hinge or pivot relative to each other, the holes 52 and the fulcrums 46 must be properly positioned to allow said halves 12 to pivot on the fulcrums 46 without applying an extending force to the adjacent bolt 14. In this connection it is essential that the inboard edges of the adjacent head 15 or nut 16 be no closer to the circular opening 21 than the adjacent fulcrums 46 (closeness of the adjacent head 15 or nut 16 to the opening 21 as herein used being defined by the radial distance in the plane of the adjacent surface 44 between the opening 21 and a normal projection of the inboard edge of the adjacent head 15 or nut 16 into said plane rather than a direct radial distance between said opening 21 and the inboard edge of the head 15 or nut 16). While it is understood that the coupling 10 can be constructed with the fulcrums 46 disposed further inwardly toward said circular opening 21, the fulcrums 46 must be at least as close to said opening 21 as the inboard edges of the adjacent head 15 or nut 16. With the fulcrums 46 disposed in this manner, the halves 12 may be hinged or pivoted relative to each other simply by removing one of the bolts 14 and it mating nut 16 from one pair of the adjacent flanges 42 without loosening the nut 16 and bolt 14 on the other pair of adjacent flanges 42. As will be seen, when the halves 12 are pivoted relative to each other, they pivot substantially on the fulcrums 46 adjacent to the remaining bolt 14 and since said fulcrums 46 are at least as close to the circular opening 21 as the inboard edges of the head 15 or nut 16 adjacent thereto, this pivoting is possible without causing an extending or stretching force to be applied on the remaining bolt 14. In addition, it is important that the holes 52 be of elongated section and oriented so that the elongated dimension thereof extend generally outwardly. In this manner sufficient clearance is provided so that the unloosened bolt 14 does not bind in its respective holes 52 as the halves 12 are pivoted. Finally, as will be seen most clearly from FIG. 8, the halves 12 must be free to pivot or open a sufficient amount to permit insertion over and/or removal from the pipe sections 18 and 20 when the gasket 37 is in place. The amount of relative pivotal movement of the halves 12 is determined substantially by the included angle defined by the divergent surfaces 48. In this connection it has been determined that in most instances a divergent included angle of at least 50° is necessary. It is understood, however, that while the surfaces 48 in the embodiment herein disclosed are defined generally by divergent planes, other configurations of the surfaces 48, such as divergent arcuate surfaces or the like may be possible.

It is seen therefore, that the instant invention provides a novel split collar or coupling construction which is easily suitable for economical mass production. The coupling halves may easily be cast from suitable materials and do not require expensive machining in their

manufacture. The couplings do, however, have the substantial advantages over the two-piece split collars or couplings previously known in that the halves thereof are pivotable or hingeable relative to one another simply by removing a single nut and bolt, and without loosening the other nut and bolt.

While there is shown and described herein certain specific structure embodying this invention, it will be manifest to those skilled in the art that various modifications and rearrangements of the parts may be made without departing from the spirit and scope of the underlying inventive concept and that the same is not limited to the particular forms herein shown and described except insofar as indicated by the scope of the appended claims.

What is claimed is:

1. A split collar for use with pipe and the like comprising a pair of opposed collar halves the inner surfaces of which cooperate to define a substantially circular opening having a central axis and an axial plane which contains said axis, outwardly extending flanges at each end of each of said halves, each of said flanges having a substantially flat inner surface which abuts the adjacent inner flange surface of the opposite half along a radial plane extending radially outwardly from said circular opening and substantially normal to said axial plane and which then diverges with respect to the opposite flange inner surface, aligned holes in said adjacent flanges, fastening means extending through said holes and substantially parallel to said axial plane operable to clamp said abutting inner surfaces of said adjacent flanges against each other to maintain said halves in assembled relation, said holes having substantial clearance inwardly and outwardly of said fastening means in a direction generally normal to said axial plane, the point at which said inner flange surfaces commence to diverge being located at least as close to said circular opening as the innermost edges of the adjacent fastening means in a direction substantially normal to said axial plane, whereby when one of said fastening means is completely removed, said halves may be swung outwardly with respect to each other without loosening the other fastening means, said outward swinging motion taking place substantially along a fulcrum located at the point where the inner surfaces of said still connected flanges commence to diverge.

2. In the split collar of claim 1, the inner surfaces of said adjacent flanges diverging to define included angles of at least 50°.

3. In the split collar of claim 1, the fastening means for at least one pair of said adjacent flanges comprising threaded nut and bolt means.

4. The split collar of claim 1 further characterized in that it functions as a pipe coupling, the inner surfaces of said halves having channels which cooperate to define a circular inner channel in said coupling, opposite sides of said channel being engageable within grooves provided adjacent to the ends of sections of pipe to be coupled.

5. In the split collar of claim 1, said aligned holes being of elongated dimension with the elongate dimension thereof extending outwardly from said circular opening substantially normal to said axial plane.

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United States Patent [19]

Sharp

[11] **Patent Number: 4,457,333**

[45] **Date of Patent: Jul. 3, 1984**

[54] **CHECK VALVE WITH RELIEF-VALVE FEATURE**

[75] Inventor: **Donald L. Sharp**, Conneaut, Ohio

[73] Assignee: **Transamerica DeLaval Inc.**, Princeton, N.J.

[21] Appl. No.: **264,457**

[22] Filed: **May 18, 1981**

[51] **Int. Cl.**^{3} **F16K 15/03**

[52] **U.S. Cl.** **137/454.2**; 137/512.1; 137/527; 251/337

[58] **Field of Search** 137/512.1, 527, 454.2; 251/337

[56] **References Cited**

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Attorney, Agent, or Firm—Hopgood, Calimafde, Kalil, Blaustein & Judlowe

[57] **ABSTRACT**

The invention contemplates a check-valve construction which exhibits substantially elevated resistance to onset of unidirectional flow (i.e., to valve opening), as compared with conventional constructions. This elevated resistance to valve-opening is achieved through use of a knuckle joint, connecting the valve member to the valve body and spring-urged to its most-spread condition when the valve member is in its closed position. The invention is shown and described in connection with a check valve having two valve members, each of which derives materially enhanced resistance to valve-opening displacement, through use of a separate spring-loaded knuckle joint associated with each of the respective valve members.

6 Claims, 4 Drawing Figures

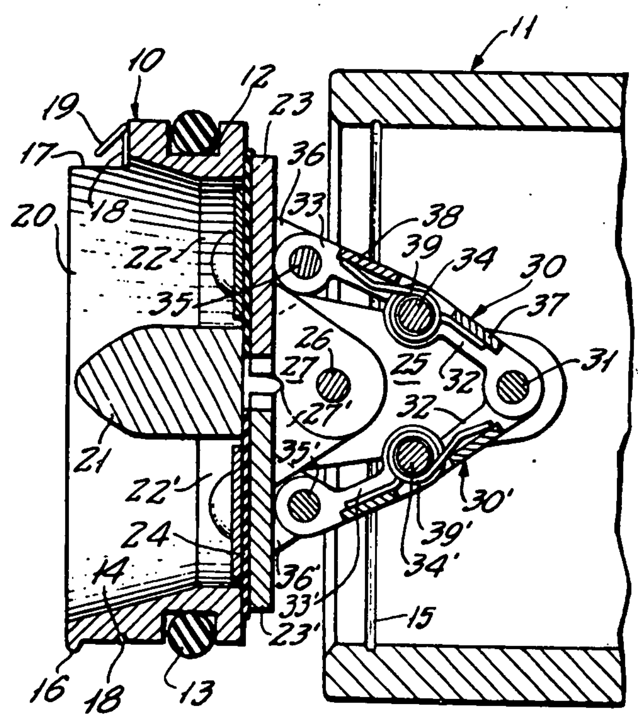


FIG. 1.

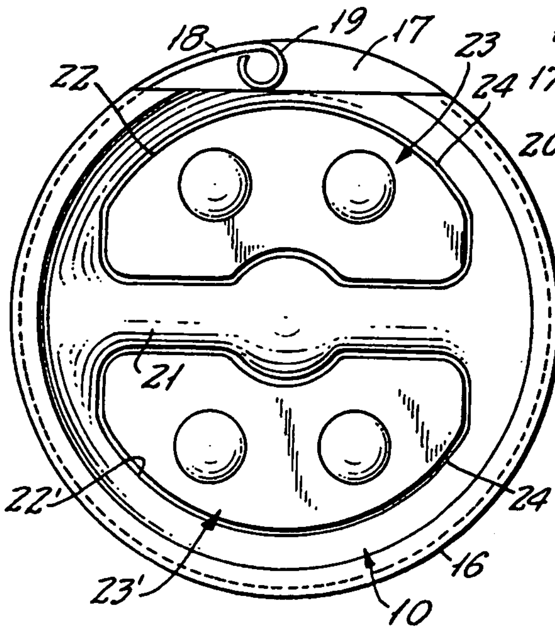


FIG. 3.

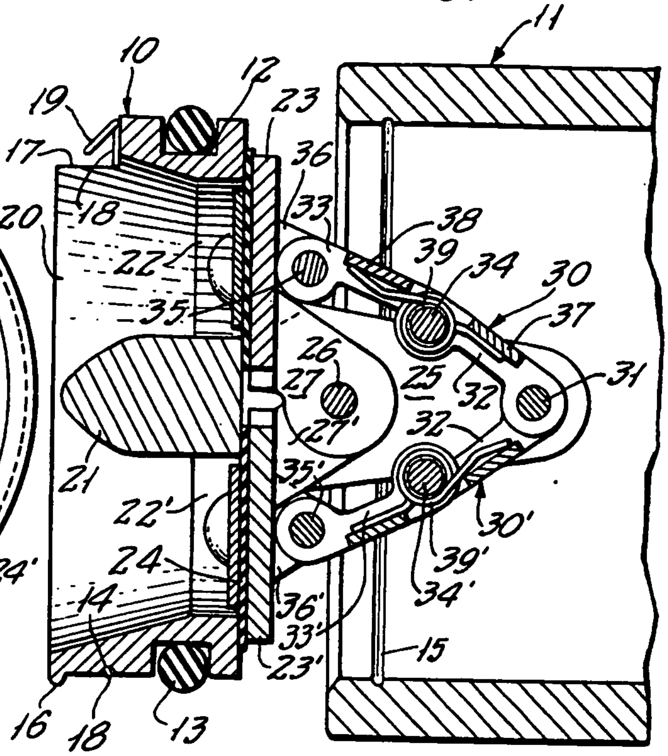


FIG. 2.

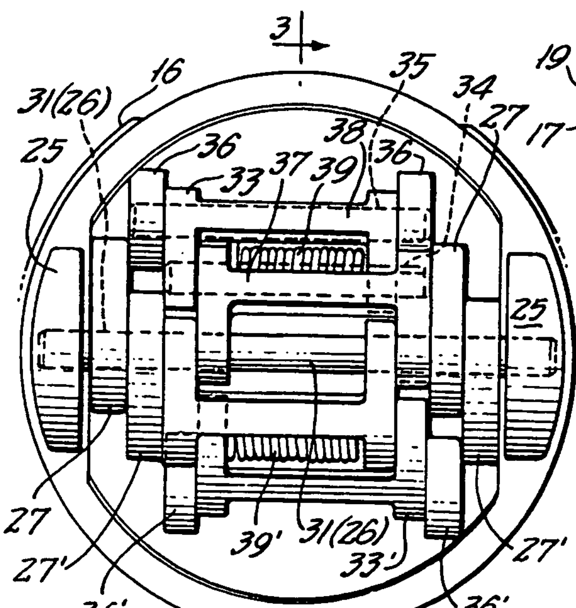
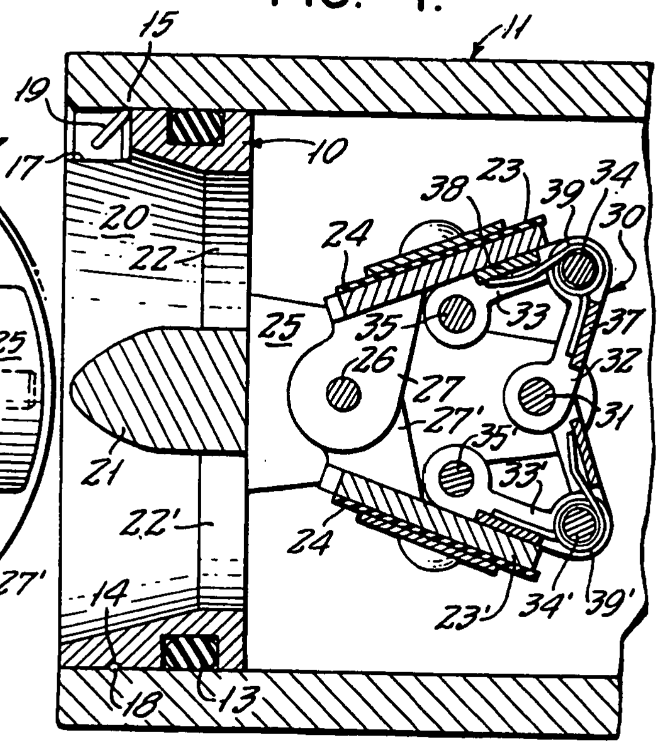


FIG. 4.



CHECK VALVE WITH RELIEF-VALVE FEATURE

BACKGROUND OF THE INVENTION

The invention relates to a check-valve construction and will be described in the context of such a valve, particularly suited to accommodation of unidirectional liquid flow, although it is in principle also applicable to check valves for fluids other than liquid.

The conventional check valve, as for unidirectional accommodation of liquid fuel when filling wing tanks of an aircraft, has one or two valve members or petals, spring-loaded for closure to a corresponding one or two valve seats. Each valve member has a pivotally hinged connection to associated valve-body structure, at a location of downstream and transverse offset from the valve seat, and the spring-loading is about the pivot axis of the valve member, as by passing the hinge pin through the center of a coil spring, with one tangential end arm referenced to the valve body and another tangential end arm preloading the valve member to closed position.

In a refueling valve of the character indicated, it is desirable to have a firm bias against valve opening, in order to avoid accidental loss of fuel during varying conditions of pressure drop across the valve member, as in high-G flight maneuvers, or when balancing the aircraft by transfer of fuel from one full tank to a more depleted tank. The traditional way to achieve such bias is to provide a more stiffly compliant, preloading spring of the character indicated. But while such a spring can elevate the force threshold required to commence valve-opening action, the fact remains that more force is required, the more the valve member is to be moved in the further-opening direction. A stiff spring of the character indicated thus necessarily imposes relatively great resistance to flow, and impairs the ability to achieve a maximum valve opening.

BRIEF STATEMENT OF THE INVENTION

It is an object of the invention to provide an improved valve construction of the character indicated.

A specific object is to provide such a valve wherein, once the valve member is caused to commence a valve-opening displacement, the resistance to furtheropening displacement will reduce or, at least, will not increase to the degree inherent in prior valve configurations.

Another specific object is to provide a check valve with the substantial equivalent of relief-valve action, in the sense that once a valve-opening displacement occurs, the valve member will quickly move to full-open condition, for maximum reduction of pressure drop across the valve in the presence of a sufficient unidirectional liquid flow.

It is also a specific object to achieve the above objects with a valve construction having the inherent ability to develop a substantially elevated threshold resistance to commencement of valve-opening displacement, as compared to prior constructions.

A further specific object is to achieve the above objects with a construction in which the full-open condition of the valve develops a substantially reduced pressure drop across the valve for a given unidirectional flow rate, as compared to prior constructions.

A still further object is to achieve the foregoing objects with spring action that is significantly less stiffly compliant than has previously been considered necessary.

A general object is to meet the foregoing objectives with inherently simple structure which is easy to service and which is adaptable to a wide variety of body configurations and applications.

The invention achieves these objects and provides certain further features by employing a knuckle joint having pivotally connected arms which have separate pivotal connection with the valve member and with the valve body and which are spring-loaded to their most-spread relation when the valve member is in its closed position. In the valve-closed position, the arm-to-arm pivot of the knuckle joint is in approach to but short of intersection with a geometrical line between the point of knuckle-arm connection to the valve member and the point of knuckle-arm connection to the body. In the position of maximum valve opening, this arm-to-arm pivot is at maximum offset from the then-existing geometrical line between these knuckle-arm connections. The configuration makes use of (a) maximum mechanical disadvantage via the knuckle to provide relatively high resistance to initial valve-opening displacement and (b) maximum mechanical advantage via the knuckle to achieve and maintain the maximum valve-open position.

DETAILED DESCRIPTION

The invention will be illustratively described in detail for a preferred embodiment, in conjunction with the accompanying drawings, in which:

FIG. 1 is a front-end view of a check valve, i.e., the upstream end of the valve, for the valveclosed condition;

FIG. 2 is a rear-end view of the valve of FIG. 1, i.e., the downstream end of the valve;

FIG. 3 is a longitudinal sectional view, taken at 3—3 of FIG. 2, to show the valve-closed relationship of parts; and

FIG. 4 is a view similar to FIG. 3, to show the valve-open relationship of parts.

The invention is shown in application to the cylindrically annular body 10 of an insert check valve of the variety lending itself to readily removable telescoping assembly to and within the bore of standard pipe or conduit, or a standard fitting therefor, an end fragment 11 of which is shown assembled to the valve body 10 (FIG. 4) and in the process of such assembly (FIG. 3). Such a structural relation is described in detail in copending Francis H. Ogle application Ser. No. 027,846, filed Apr. 6, 1979, now U.S. Pat. No. 4,257,444 to which reference is made for full discussion.

It suffices here merely to identify a first circumferential body groove 12 to retain an elastomeric O-ring 13 for sealing engagement to the bore of the tubular member 11, a second and smaller circumferential body groove 14 for axial register with a similar but inwardly open tubular-bore groove 15, and a radially outward body lip 16 to engage the outer end of the tubular bore and thus to identify the limit of telescopic assembly at which grooves 14–15 are in register. The lip (16) end of body 10 is locally recessed at 17 to an axial extent which includes the groove 14, and the angular limits of recess 17 are less than the remaining circumferential extent of the groove 14. When grooves 14-15 are in register, a stiffly compliant locking wire 18 is selectively manipulable, via an offset loop 19 at one end, into or out of such circumferentially extensive accommodation within the annular space defined by grooves 14–15 as to provide virtually circumferentially continuous distribution of

retention force for the insert-valve assembly, via its body **10**.

For the relationship shown, the body **10** provides a relatively large cylindrical through-passage **20** for unidirectional flow in the direction shown by legend, between an upstream end (at the left, in the sense of FIGS. **3** and **4**) and a downstream end, fully contained within the bore of tubular member **11**. A diametrically extending seat post **21** is an integral part of body **10** and divides passage **20** into two like, generally semicircular seat openings **22–22'**, against the downstream rims of which first and second valve members or petals **23–23'** peripherally seal (via an elastomeric liner **24**) when in valve-closed position (FIG. 3). Diametrically opposed downstream projections or pedestals **25** are integral formations of body **10** and establish end mountings for a diametrically extending hinge pin **26**, to which hinge arms **27** (**27'**) of valve members **23** (**23'**) are both pivotally connected, it being noted that the pivot axis established by pin **26** is offset both downstream and transversely, with respect to the radial plane and to the eccentric offset of each seat perimeter; it is also noted that each valve member **23** (**23'**) has two hinge arms **27** (**27'**) at such spacing and offset as to place one hinge arm **27** (**27'**) of each valve member into interlaced adjacency with one pedestal **25**, while placing the other hinge arm **27** (**27'**) into similar interlaced adjacency with the other pedestal **25**.

Separate knuckle-joint subassemblies **30** (**30'**) provide further interconnection of the valve-members **23** (**23'**) with the body **10**, and in the form shown the body reference for both subassemblies **30** (**30'**) is provided by a second pivot pin **31** end-mounted to the spaced pedestals **25** and at a location of further downstream offset from pivot pin **26**. Each knuckle-joint subassembly, such as subassembly **30** comprises two arms **32–33**, having knuckle-end pin connection **34** to each other; the outer end of arm **32** has pivotal connection to the body-reference pin **31**, while the outer end of arm **33** has pivotal connection at **35** to lugs **36** forming part of valve member **23**. More specifically, each arm **32** integrally comprises two spaced side members with a connecting bridge **37**, and each arm **33** integrally comprises two spaced side members with a connecting bridge **38**. The side members of the respective arms **32–33** are in nested interlace, and a coil spring **39** is located on knuckle pin **34** in the space between adjacent corresponding side members of the arms **32–33**; the tangentially extending ends of spring **39** are in preloaded engagement with bridges **37–38**, in the sense urging arms **32–33** to their most-spread relation (FIG. 3).

All pivot pins **26–31–34–35** are parallel to each other, and in the most-spread relation of arms **32–33**, the axis of knuckle pin **34** is in approach to but short of intersection with a geometrical line or plane between the outer-end pin axes at **31–35**. In the full-open condition of valve member **23**, the angular spread between kunckle arms **32–33** is reduced to a minimum (thereby increasing the spring load on arms **32–33**), and knuckle pin **34** is at maximum offset from the thenexisting geometrical line or plane between the outerend pin axes at **31–35**.

Parts described for the knuckle-joint subassembly **30** apply equally for the knuckle-joint subassembly **30'**, and they are given the same reference numbers, with primed notation to avoid confusion.

In its valve-closed condition, the described construction will be seen to establish almost (but not quite) a straight-line or single-plane relation between pivot axes **31–34–33** of a given knuckle-joint subassembly **30**. This relation, in the context of a given preload spring **39**, will present relatively great mechanical disadvantage to any pressure applied on the upstream side of the applicable valve member **23**, meaning that a relatively high threshold force must be developed before the valve member **23** can begin to move from its closed position. However, once this threshold force is attained and any valve-opening displacement occurs, there is an immediate increase in the offset of knuckle pin **34** from the then-existing geometric line or plane between axes of pins **31** and **35**, accompanied by a marked decrease in the indicated mechanical disadvantage. In fact, the mechanical disadvantage decreases so rapidly with incremental advance in the opening displacement of the valve member that the valve member virtually snaps to its full-open condition (FIG. 4) soon after valve-opening displacement commences. Once fully open, the mechanical disadvantage has been replaced by mechanical advantage, so that relatively little knuckle-compressing force is required from the unidirectional fluid flow in order to maintain the full-open condition. And in view of the relatively small force needed to hold the full-open condition, the drag or resistance to flow through the valve is at a minimum. Of course, what has been said for valve member **23** and its knuckle system **30** applies equally and concurrently for valve member **23'** and its knuckle system **30'**. And when flow terminates, even relatively softly compliant springs **39** (**39'**) are sufficient to restore the fully closed condition of both valve members.

It will be seen that the described valve system meets all stated objectives with a check valve that acts virtually like a relief valve, in that once the predetermined opening threshold is reached, the valve pops into its full-open position. The extent of mechanical disadvantage at valve-closed position can be built into any given design, by specification of the minimum offset of axis **34** from the line joining axes **31–35** for the valve-closed position, and a further dimension of control is obtained through suitable choice of the relatively weak spring **39** and its preloading condition. For purposes of comparison, it can be stated that for a given size valve body with two hinged valve members, the threshold pressure to open the described valve can be in the order of 10 psi with a weak spring **39**, while a conventional valve of the same size and equipped with a relatively stiff spring on the hinge pin **26** provides a maximum valve-opening threshold pressure of only 2 psi. And, as noted above, the conventional valve, once opened, necessarily offers substantially greater resistance to fluid flow and requires much greater force to maintain the full-open condition.

While the invention has been described in detail for a preferred form, it will be appreciated that modifications may be made without departure from the claimed scope of the invention. It will also be appreciated that the described valve structure has uses other than the fueling application mentioned above. For example, in view of its relatively high threshold for determination of initial valve opening (followed by fast transition to full-open condition), the valve of the invention offers a simple and less expensive substitution for the more familiar poppet-valve version of a relief valve. More specifically, the indicated high threshold qualifies the described valve to perform safety-relief venting of pressure to protect a fluid system, or for the quick and effi-

cient drainage of fuel from aircraft prior to hangar storage.

It will be understood that although the two arms 32-33 (32'-33') of each knuckle-arm linkage 30 (30') have been described as spring-loaded in their spreading direction (in the context of spring 39 being mounted on knuckle pin 34, with loading-arm contact on both arms), such descriptive language is also applicable to other spring-loading arrangements, such as a single coil spring carried by pin 31, with loading-arm contact at one end with bridge 37 of arm 32 and at the other end with bridge 37' of arm 32'.

What is claimed is:

1. In a check valve, a generally cylindrically annular valve body having a through-passage between an upstream end and a downstream end, a seat region in substantially a radial plane with respect to the axis of said passage, said body including a seat post extending across said passage at said radial plane and establishing two seat regions on opposite sides of said seat post, separate movable valve members each of which is configurated on its upstream or seat-engageable side for peripherally continuous closing relation with one of said seats in one position, the downstream side of each said valve member having a hinge-arm formation for valve-member articulation about a hinge axis offset both downstream and laterally with respect to the seat-engageable side of said valve member, means including a single body-mounted hinge pin pivotally mounting said valve members on a common hinge axis, said hinge pin extending diametrically of said body and being located downstream from said seat region, first and second knuckles each of which comprises two link arms pivotally connected at their inner ends, the outer end of one link arm of each knuckle being pivotally connected to said body at a location downstream from said hinge pin, the outer end of the other link arm of each knuckle being pivotally connected to the downstream side of one of said valve members at a location that is offset from the valve-member hinge axis, the distance between outer-end pivot connections of said link arms when in valve-closing position being less than the combined pivot-to-pivot distances of said link arms, and spring means reacting between said link arms of the respective knuckles about their inner-end pivot connection and urging said link arms in the direction of their respective valve-closing positional relations, the body connection of said knuckles being on a single axis that is parallel to the hinge axis of the respective valve members.

2. In a check valve as an article of manufacture, comprising a cylindrically annular body which includes a diametrically extending seat post dividing the opening of said body into two like opposed generally semicircular valve seat openings to share fluid flow in a single downstream direction through said body, and two valve members hinged to said body to open and close said openings, the improvement wherein each of said valve members is urged to closed position via knuckle-joint arms which are spring-loaded in their spreading direction, each valve member being pivotally connected to one outer knuckle-joint arm end and said body having pivotal connection to the other outer knuckle-joint arm end, each of said valve members being seated at its valve-seat opening when the associated knuckle-joint arms are in their most-spread relation, and said other outer arm ends sharing a common pivot-axis connection to said body.

3. A check valve, comprising a cylindrically annular body including a diametrically extending seat post dividing the opening of said body into two like opposed generally semicircular valve-seat openings to share fluid flow in a single downstream direction through said body, first and second diametrically extending pins carried by said body at different downstream offsets from and parallel to said seat post, a separate valve member for independent opening and closing of each valve-seat opening and hinged to the pin at nearer offset from said seat post, and a separate knuckle joint associated with each valve member, each said knuckle joint comprising two pivotally connected arms which are spring-loaded in their arm-spreading direction, each valve member being pivotally connected to one outer end of its associated knuckle joint and said body having pivotal connection to the other outer end of said associated knuckle joint via the other of said pins, and each of said valve members being seated at its valve-seat opening when the associated knuckle-joint arms are in their most-spread relation.

4. The check valve of claim 3, in which the external surface of said body is a cylinder having a cirumferential radially outwardly open seal-ring groove near one axial end, a radially outward lip formation near the other end, and a radially outwardly open retaining-ring groove between said seal-ring groove and said lip formation.

5. The check valve of claim 4, in which the other axial end of said body is locally recessed to an axial extent which includes said retaining-ring groove but which is axially short of intercepting said seal-ring groove, the angular limits of said recess being less than the remaining circumferential extent of said retaining-ring groove.

6. The check valve of claim 3, wherein for said most-spread relation of each knuckle joint the pivot connection of said arms to each other is in approach to but short of intersection with a geometric line between the valve-member connection and the body connection.

* * * * *

United States Patent [19]

Dixon

[11] **Patent Number: 4,508,138**

[45] **Date of Patent: Apr. 2, 1985**

[54] **POLYJET VALVE WITH BACKWASH**

[75] Inventor: **Robert W. Dixon**, Concord, Calif.

[73] Assignee: **Chas. M. Bailey Co., Inc.**, Emeryville, Calif.

[21] Appl. No.: **520,639**

[22] Filed: **Aug. 5, 1983**

[51] Int. Cl.^{3} **F16K 3/26**; F16K 11/07

[52] U.S. Cl. **137/239**; 137/546; 137/625.3; 137/625.38; 137/625.39; 138/45; 138/46; 251/205; 251/210; 251/121; 210/411; 210/427

[58] **Field of Search** 137/219, 239, 625.3, 137/625.38, 625.39, 599, 599.1, 544, 547, 549, 550; 251/121, 205, 210; 138/45, 46; 210/411, 427, 429

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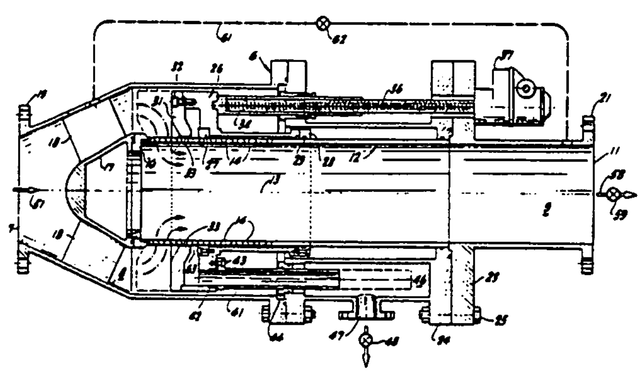
Primary Examiner—George L. Walton

Attorney, Agent, or Firm—Lothrop & West

[57] **ABSTRACT**

A polyjet valve has an inlet opening into an inlet chamber normally communicating through a movable polyjet sleeve in variable amounts and in one direction with an outlet chamber having an outlet. There is a block to close the outlet and a conduit to establish backflow from the outlet chamber through the polyjet sleeve in the reverse direction and then to waste.

8 Claims, 2 Drawing Figures



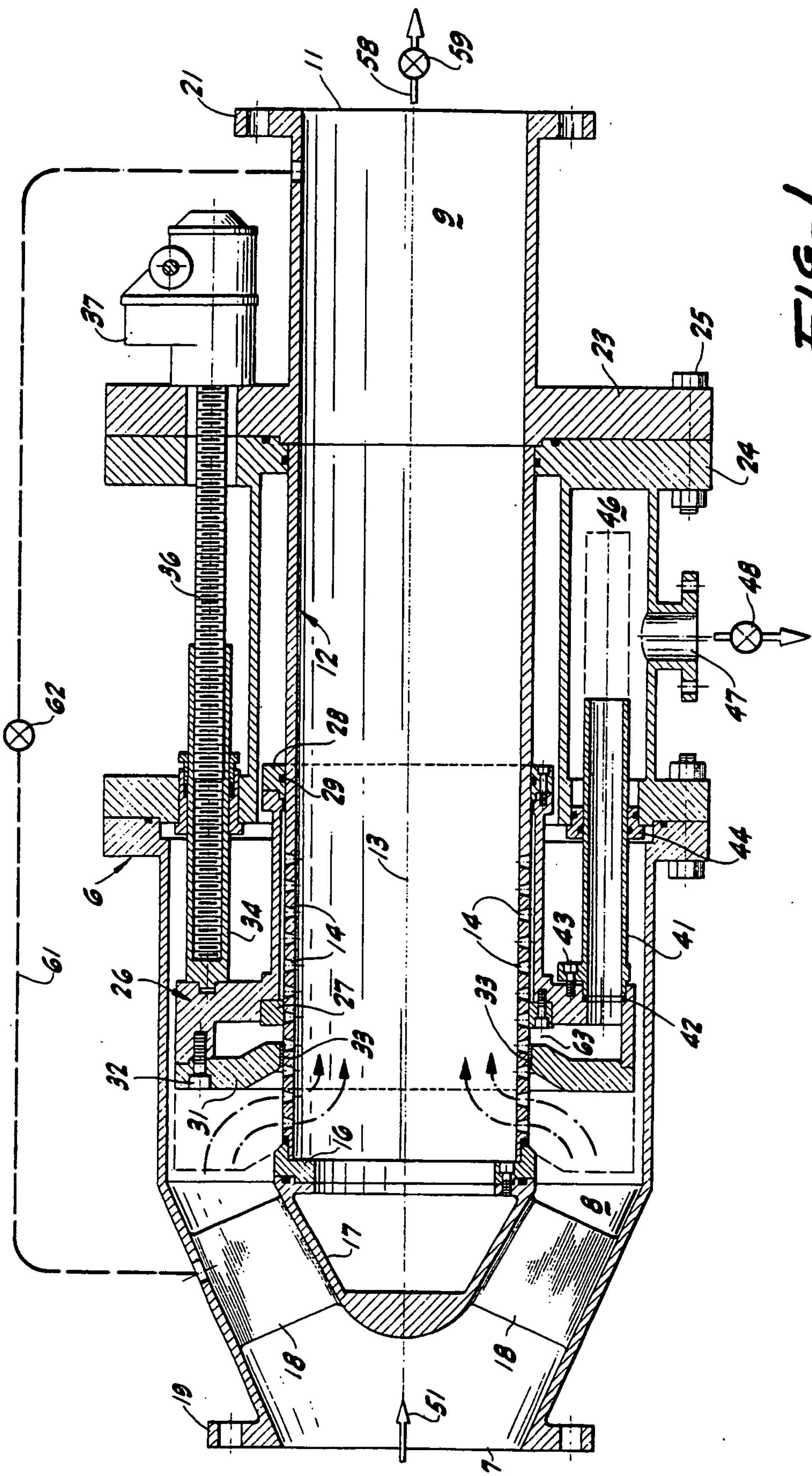


FIG-1

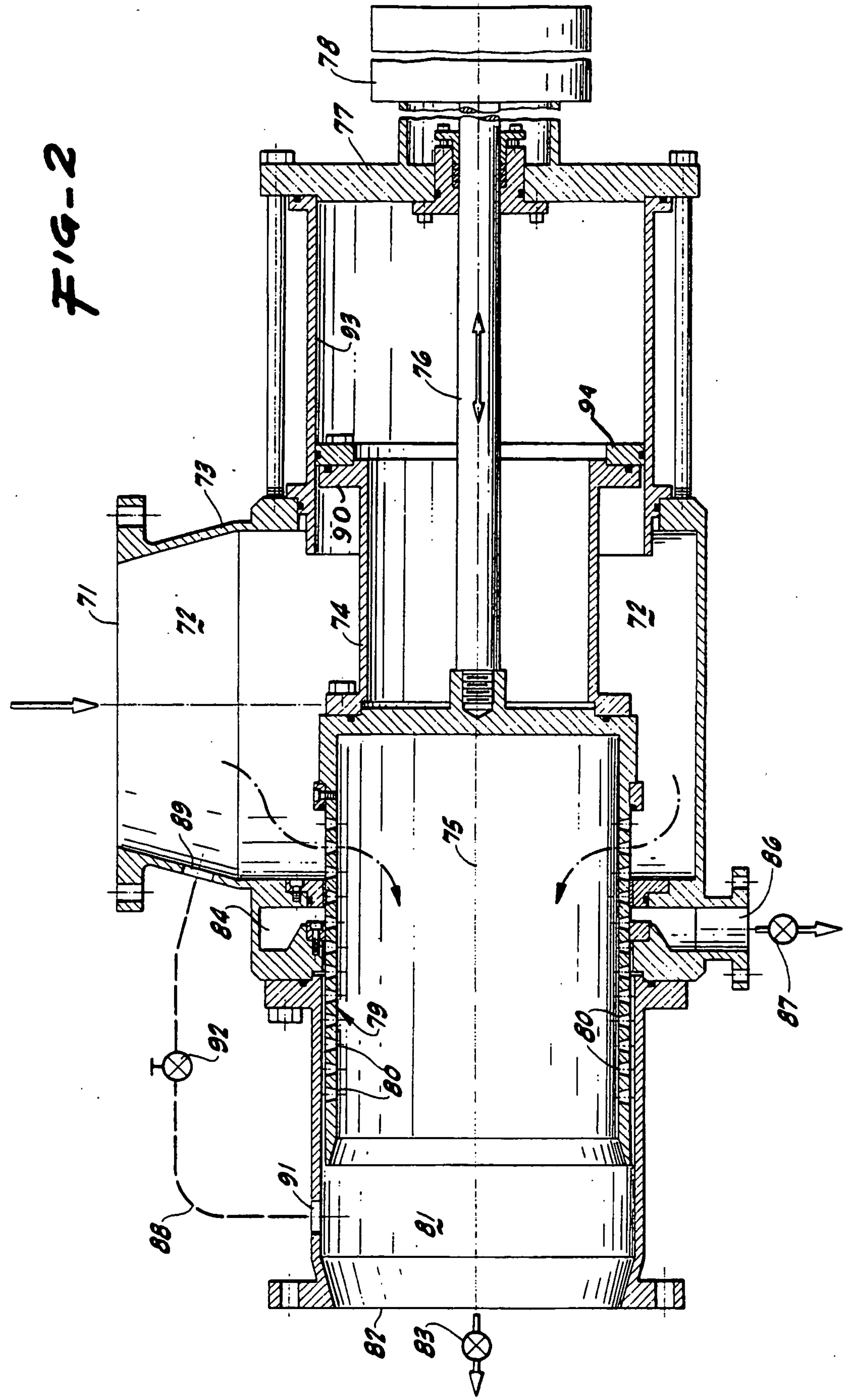

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FIG-2

POLYJET VALVE WITH BACKWASH

BRIEF SUMMARY OF THE INVENTION

A polyjet valve has an inlet opening into an inlet chamber normally communicating through various polyjet openings in a cylindrical sleeve in variable amounts in one direction toward an outlet chamber having an outlet. There is a traveling ring surrounding the sleeve and movable to close the openings and an annular channel in the traveling ring to establish backflow from the outlet chamber progressively through different openings in the polyjet sleeve and into the annular channel open to some of said openings in the reverse direction and then to waste.

PRIOR ART

The most pertinent prior art known to me presently is U.S. Pat. No. 3,605,787 issued Sept. 20, 1971 to Ralph J. Krogfoss and myself for a polyjet valve. This valve is a fundamental portion of the current disclosure, but does not have any indication of the currently disclosed manners of maintaining, cleaning and backwashing the valve.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

FIG. 1 is a longitudinal cross-section on two planes at right angles to each other through one form of polyjet valve according to the invention showing provisions for a backwash operation.

FIG. 2 is a similar cross-section of another form of polyjet valve pursuant to the invention showing another form of arrangement for effectuating a backwash function.

DETAILED DESCRIPTION

In the embodiment shown in FIG. 1 there is provided a valve body 6 made up of various component portions having an inlet 7 opening into an inlet chamber 8 and communicating with an outlet chamber 9 having an outlet 11. Intermediate the chambers 8 and 9 there is a polyjet sleeve 12 symmetrical about a longitudinal axis 13 and inclusive of a very large number of jet openings 14, preferably of tapering cross-section, with the wider or larger portion toward the outside of the valve and the smaller or narrower portion toward the inside of the valve. These are axially spaced and extend radially and circumferentially in a pattern preferably as disclosed in U.S. Pat. No. 3,605,787.

The sleeve is preferably supported at one end through a ring 16 in engagement with a nose cone 17 joining the remainder of the body by means of intervening vanes 18 spaced apart to allow free fluid flow. The walls of the chamber 8 merge with an inlet flange 19 for securing the body 6 to an adjoining hydraulic conduit (not shown) by means of the customary fastenings. The outlet chamber 9 is within a portion of the main body 6 having an attachment flange 21 with a provision for securing the body 6 to another structure such as an outlet conduit. The body 6 also incorporates flanges 23 and 24 held together by bolts 25 so as to afford a detachable assembly.

Movable over the outside of the sleeve 12 is an axially traveling ring 26 inclusive of bearings 27 and 28 movable on the outside of the sleeve, the bearing 28 being provided with a packing or O-ring 29. The ring bearings 27 and 28 are supplemented by a bearing ring 31 secured to the traveling ring 26 by removable fastenings 32 and having an anti-friction lining 33. To move the traveling ring 26 there is provided an internally threaded sleeve 34 secured to the ring and in interengagement with a screw 36 that is rotated by a driver 37, shown diagrammatically.

Preferably there are two diametrically opposite ring moving devices such as the sleeve 34, the screw 36 and the impeller 37. Intermediate such devices, preferably also on a diameter, are tubes 41 at one end tightly secured to the ring 26 by means of a packing ring 42 and a fastening hub 43. The tube 41 extends slidably through a packing structure 44 and telescopes into a drain chamber 46 incorporated within the body 6 and having a drain opening 47 controlled by a manual valve 48.

In the normal operation of this structure, fluid under pressure is introduced through the inlet 7 and flows in the direction of the arrow 51 into the annular space between the wall of the body and the inner sleeve 12. In the event one or more of the openings 14 is uncovered, the liquid then flows through the openings 14 to the interior of the sleeve 12 and then flows in an axial direction to the outlet chamber 9. From there, flow continues through the outlet 11 usually into a connected pipe or conduit 58 controlled by a normally open valve 59, the outlet flow being in the direction of the arrow.

When the actuating drivers 37 are energized, the screws 36 are rotated and the threaded sleeves 34 and the traveling ring 26 are moved axially, either to uncover additional ones of the openings 14 or to cover some or all of the openings. By thus traversing the traveling ring 26 in an axial direction, the amount of flow through the valve can be controlled, depending upon the number of the openings 14 that are made available.

While the valve operates admirably for the control of flow quantities under most all circumstances, there are some installations in which there is sufficient debris in the liquid to clog the openings 14.

To overcome the difficulty a special provision is made. There is an arrangement for backwashing the openings. The flow direction is temporarily reversed. To arrange for backwashing, the valve 59 is easily closed to seal off the outlet 11. Liquid from the inlet chamber 8 is directed to flow through a shunting line 61 through a control valve 62 to the closed off outlet chamber 9. The shunted liquid flows through the center or interior portion of the polyjet sleeve 12 and radially outwardly through the openings 14 in a direction the reverse of normal flow. Fluid flows through the then-exposed ones of the openings 14 into an annular groove 63 within the traveling ring 26. Flow is from that groove 63 through the tubes 41 into the draining chamber 46 and from there through the outlet 47, since the valve 48 is correspondingly opened. This outflow goes to waste. By traversing the axially relatively short or narrow annular groove 63 over the longer array of openings, the flushing pressure is concentrated on a few holes at a time affording good cleansing action. By traversing the traveling ring along the length of the polyjet sleeve 12, all of the openings 14 are sequentially are exposed to the backflow liquid. The entire sleeve 12 is thus purged of any debris. The control valves can be returned to normal positions and the usual flow can be resumed.

In the embodiment of the invention disclosed in FIG. 2 there is similarly provided an inlet 71 to an inlet cham-

ber 72 at one end of a valve body 73 made up of various different portions. The inlet chamber 72 extends around a sleeve 74 movable along an axis 75 by means of an axial propelling rod 76. The rod extends through a bearing and packing gland in an end plate 77 secured to a separable part of the body 73 and connects to an actuating structure 78. The rod 76 can be moved to and fro and the sleeve 74 moves with it. The sleeve 74 is joined to a coaxial polyjet sleeve 79. The polyjet sleeve 79 for much of its length is provided with a number of individual polyjet openings 80 usually affording flow from the inlet chamber 72 into the interior of the polyjet sleeve 79. This usually is in communication with an outlet chamber 81 having an outlet 82 adapted to be secured to any connecting structure (not shown) and preferably is provided with a closure valve 83.

The valve body 73 is inclusive of an enclosed annular groove 84 surrounding a fraction of the oxide length of the polyjet sleeve 79. From the annular groove 84 is an outlet 86 controlled by a valve 87 and going to waste.

There is a shunt line 88 having one end connected through an opening 89 to the inlet chamber 72 and having its other end going through an opening 91 to the outlet chamber 81. A valve 92 regulates or controls flow through the shunt line 88. The sleeve 74, opposite the end connected to the polyjet sleeve 79, has a terminal flange 90 slidable in a cylinder 93 compressed between the valve body 73 and the end plate 77. A bearing ring 94 carrying an O-ring and abutting an O-ring affords a substantially non-leaking arrangement.

In the normal operation of this structure, pressure fluid from the inlet chamber 72 flows through whatever openings 80 are available or uncovered. Flow is then into the interior of the polyjet sleeve 79. When the valve 83 is open, flow continues through the outlet 82. The valves 87 and 92 are normally closed, so there is no shunt flow and no flow to waste. In order to accomplish backwashing, the waste valve 87 is opened, the outlet valve 83 is closed and the shunt valve 92 is opened. Pressure fluid from the inlet chamber 72 then passes through the opening 89 and through the shunt line 88 and through the opening 93 into the chamber 81. There is then flow radially outwardly through whatever small number of the openings 80 are momentarily in communication with the relatively narrow annular groove 84. This flow through the openings 80 is contrary to the normal direction of flow. The outflow into the annular groove 84, as the polyjet sleeve 79 is moved axially to and fro, goes out to waste through the temporarily open valve 87. In this way a few at a time of the various openings in the polyjet sleeve are individually and progressively subjected to a liquid pressure flow through them contrary to the normal direction of flow. Debris lodged therein due to flow in the normal direction is subjected to a reverse flow and is dislodged and discharged from the outlet 86.

I claim:

1. A valve comprising a body including means defining an inlet chamber disposed about an axis; means defining an outlet chamber disposed about said axis and adapted to communicate with said inlet chamber; a cylindrical polyjet sleeve disposed between said chambers and extending along said axis and having a plurality of radially extending, circumferentially arranged, axially spaced discrete openings therethrough and adapted to communicate with said inlet chamber and said outlet chamber, each of said openings having a predetermined axial length; a ring coaxial with and engaging said sleeve and defining an annular groove open to said sleeve and of substantially said predetermined axial length; means for moving said polyjet sleeve and said ring relative to each other along said axis for moving individual ones only of said openings progressively into registry with said annular groove regardless of the position of said ring; means for substantially blocking outflow from said outlet chamber; means for providing a drain from said annular groove; and means for circulating wash fluid from said inlet chamber into said outlet chamber and through successive individual ones only of said openings into said annular groove regardless of the position of said ring and into and through said drain.

2. A valve as in claim 1 in which each of said openings is tapered along its own axis with the smaller end opening into the interior of said cylindrical polyjet sleeve, and means for directing said wash fluid to flow through said openings from the larger end thereof toward the smaller end thereof.

3. A valve comprising means defining an inlet chamber symmetrical about a main axis, means defining an outlet chamber having an outlet and symmetrical about said main axis and at least in part telescoped with said inlet chamber, a circular-cylindrical polyjet sleeve symmetrical about said main axis and on one side open to said inlet chamber and on the other side open to said outlet chamber, means defining a plurality of axially spaced openings through said polyjet sleeve adapted to communicate with said inlet chamber and said outlet chamber, each opening having an individual axial length of a predetermined amount, a ring engaging said sleeve, means defining an annular groove in said ring open to said sleeve and circular-cylindrical about said main axis and of only said predetermined axial length, means for moving said sleeve and said ring axially relative to each other to move only individual ones of said openings progressively into registry with said annular groove, means for directing water to flow from said inlet chamber into said outlet chamber through said polyjet openings in one direction, means for closing said outlet, means for directing water in an opposite direction to flow from said closed outlet chamber through successive ones only of said polyjet openings into said annular groove when said sleeve and said ring move relative to each other regardless of the position of said ring, and means for conducting the water from said annular groove to drain.

4. A valve comprising a valve body symmetrical about a main axis and having an upstream inlet at one end and a downstream outlet at the other end, means for closing said outlet, means within said valve body defining an annular groove symmetrical about said axis and of a predetermined axial length, a circular-cylindrical polyjet sleeve within said body and axially movable relative to and across said annular groove, means in said polyjet sleeve defining a plurality of openings, each opening having said predetermined axial length and being disposed with its own axis substantially normal to said main axis and said openings being spaced apart along said main axis to direct water to flow from said inlet to said outlet in one direction, a drain outlet from said annular groove, means for closing said outlet, and means for directing water to flow away from said outlet when said outlet is closed and through successive individual ones only of said openings in said polyjet sleeve into said annular groove regardless of the position of said sleeve and then into said drain outlet.

5. A valve comprising a body having an inlet means and an outlet means, means to closing said outlet means, a circular-cylindrical sleeve substantially symmetrical about a main axis and having a plurality of individual axially spaced openings therethrough, each of said annular openings having its own individual axis disposed substantially normal to said main axis, means for progressively subjecting substantially all of said openings to simultaneous water flow therethrough in one direction along said individual axes thereof, and annular means surrounding said cylindrical sleeve for progressively subjecting only one of said annular openings to water flow therethrough in the opposite direction along said individual axes thereof when said outlet means is closed regardless of the position of said sleeve during linear movement of said sleeve.

6. A valve comprising a body having a water inlet and having a closable water outlet, a circular-cylindrical sleeve within said body and open on one side of said sleeve to said water inlet and open on the other side of said sleeve to said water outlet, means defining a plurality of annular openings through and axially spaced apart along said sleeve, and means for directing water from said inlet to flow in a pretermined direction through all of said openings, annular means surrounding said cylindrical sleeve effective when said outlet is closed for directing water to flow only through progressively selected ones of said openings in a direction opposite to said predetermined direction regardless of the position of said sleeve during linear movement of said sleeve, and means for draining from said valve water flowing in said opposite direction through said selected ones of said openings.

7. A valve having a body with an inlet adapted to receive the flow of water and an outlet adapted to exit the flow of water, means for closing said outlet means within said body between said inlet and said outlet and including a polyjet sleeve extending axially and having a plurality of axially discrete openings therethrough, each opening being of a predetermined axial dimension and arranged along a predetermined length of said polyjet sleeve, means in said body defining an annular groove surrounding said polyjet sleeve, said groove and said openings having substantially the same said predetermined axial dimension, means connecting said annular groove to waste, and means for relatively moving said polyjet sleeve and said annular groove in one direction to direct the flow of water from said inlet to said outlet through substantially all of said openings and in an opposite direction to connect only one of said openings in sequence to said annular groove regardless of the position of said sleeve relative to said groove when said outlet is closed.

8. A valve comprising a body having an inlet to receive a fluid flow and an outlet for exiting the fluid flow, means for closing said outlet, a cylindrical polyjet sleeve extending along an axis between said inlet and outlet and provided with a plurality of openings therein of predetermined axial length arranged along said sleeve in circumferentially and axially spaced locations, a coaxial ring encompassing and bearing on said sleeve, means for relatively moving said ring and said sleeve axially, means on said ring constituting a solid portion thereof adapted in various axial positions of said ring to overlie and block some of said openings, means on said ring defining an annular groove of said predetermined axial length adapted in various different axial positions of said ring relative to said sleeve to communicate with only correspondingly different axially spaced ones of said openings in one direction to direct the fliud flow from said inlet to said outlet, means for directing fluid to flow through only one of said different ones of said openings in communication with said groove in an opposite direction when said outlet is closed regardless of the position of said sleeve relative to said groove, and means for conducting said fluid flow from said annular groove away from said valve.

* * * * *

United States Patent [19]

Dixon

[11] **Patent Number: 4,520,846**

[45] **Date of Patent: Jun. 4, 1985**

[54] **VALVE**

[75] Inventor: **Robert W. Dixon, Concord, Calif.**

[73] Assignee: **Chas. M. Bailey Co., Inc., Emeryville, Calif.**

[21] Appl. No.: **523,142**

[22] Filed: **Aug. 15, 1983**

[51] Int. Cl.[3] **F16K 3/26**

[52] U.S. Cl. **137/625.3**; 137/625.38; 251/63.5

[58] Field of Search 137/625.3, 625.37, 625.38, 137/625.39; 251/344, 63.5

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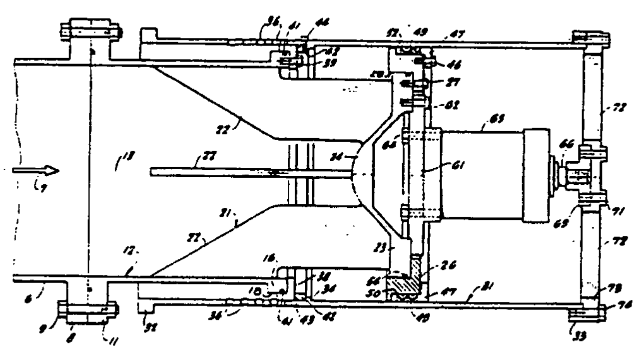
3,605,787	9/1971	Krogfoss et al.	137/625.38 X
4,080,982	3/1978	Maezawa	137/625.3 X

Primary Examiner—Arnold Rosenthal
Attorney, Agent, or Firm—Lothrop & West

[57] **ABSTRACT**

A valve, primarily to control hydraulic flow, has a mounting tube ending in a disc spaced from the end of the tube to allow a flow passage. A polyjet sleeve, with multiple orifices through its wall, is axially slidable along the exterior of the mounting tube and on the exterior of the disc. An actuator, preferably hydraulic, moves the polyjet sleeve across the flow passage to vary the effective size of the flow passage.

1 Claim, 3 Drawing Figures



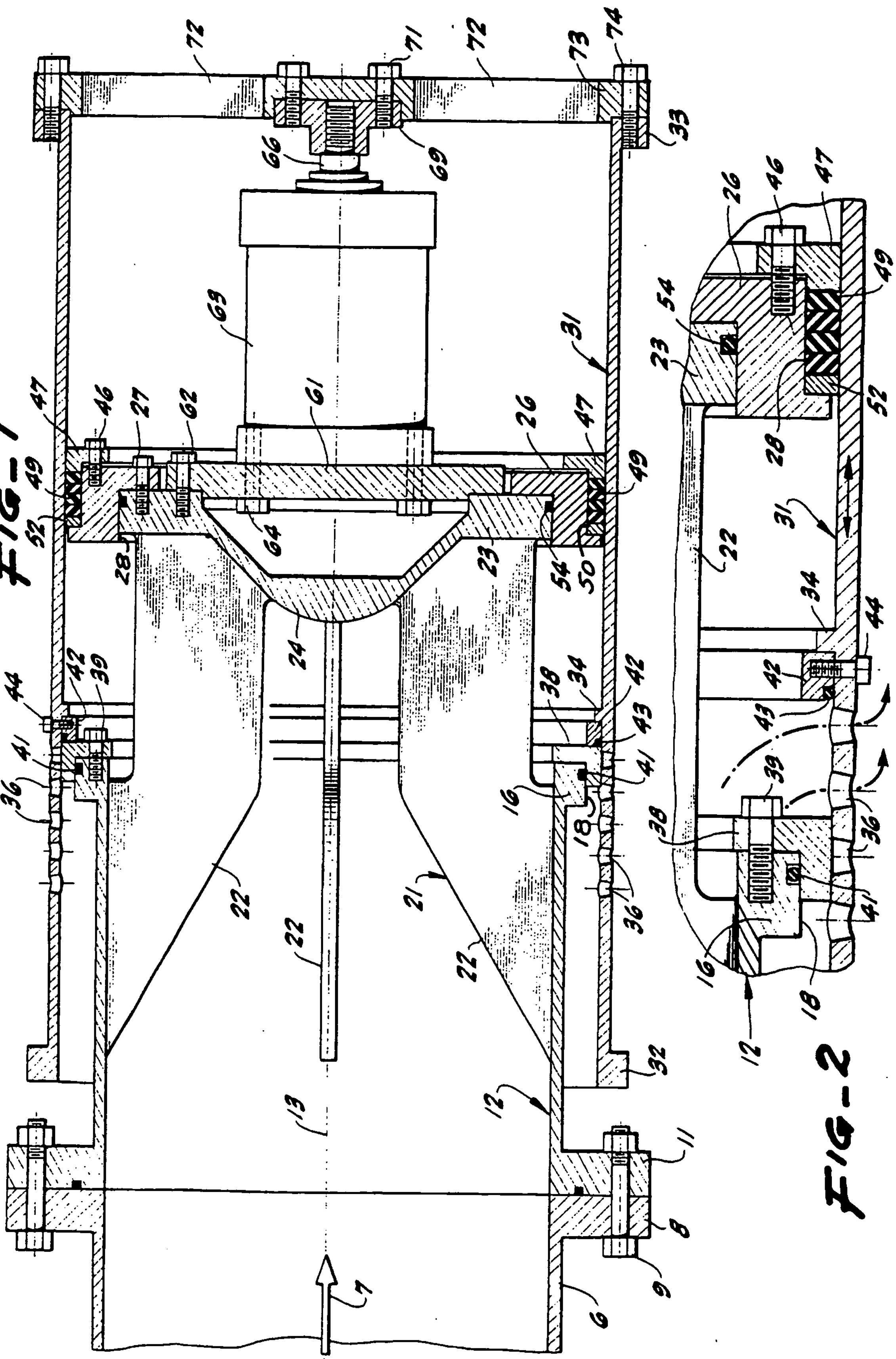


FIG-1

FIG-2

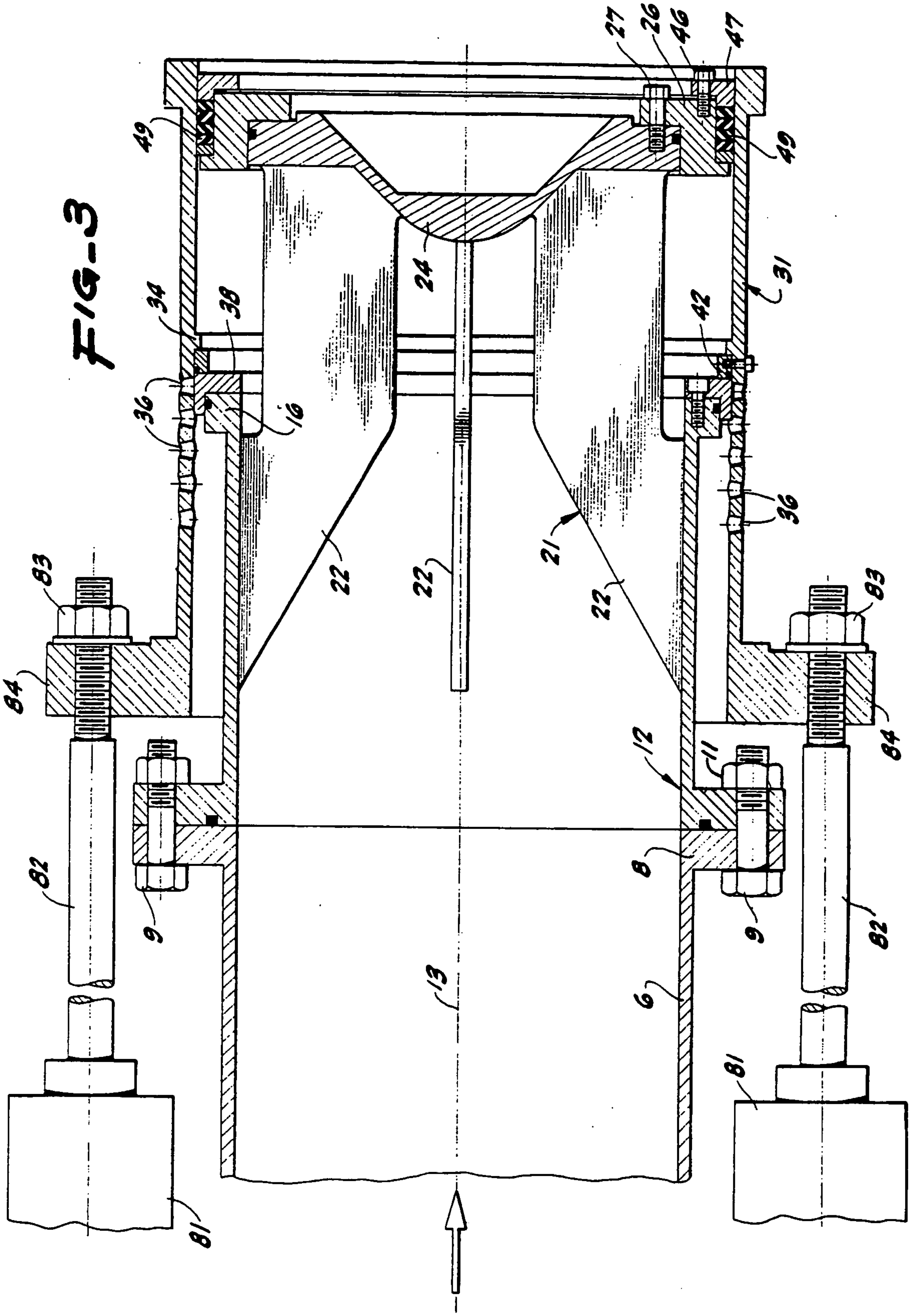

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FIG-3

VALVE

CROSS-REFERENCES TO RELATED APPLICATIONS

Co-pending with this application are two patent applications entitled "POLYJET VALVE WITH BACKWASH" and "DISCHARGE VALVE", the first being Ser. No. 520,639 filed Aug. 5, 1983, and the other being Ser. No. 520,650 filed Aug. 5, 1983.

BRIEF SUMMARY OF THE INVENTION

For use in controlling the flow of water, particularly for massive fluid discharge, a fixed mounting tube, concentric with an axis, slidingly supports a surrounding polyjet sleeve perforated with a large number of orifices. There is also a fixed supporting disc slidingly engaging the interior of the polyjet sleeve and itself supported from the mounting tube by a spider. A hydraulic cylinder and piston arrangement is utilized for moving the external polyjet sleeve axially along the mounting tube and over the supporting disc for controlling the number of polyjet openings available for throughflow of the fluid.

PRIOR ART

The principal prior art of interest is U.S. Pat. No. 3,605,787 issued Sept. 20, 1971 to Krogfoss and Dixon. This shows a valve of the polyjet type but differs substantially from the present disclosure.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

FIG. 1 is a cross-section on a longitudinal, diametrical plane through a valve constructed pursuant to the invention and utilizing one form of polyjet sleeve moving device, the valve being in closed position.

FIG. 2 is an enlargement of a portion of the showing of FIG. 1 with the valve in partially open position.

FIG. 3 is a view comparable to FIG. 1, but showing a different form of polyjet sleeve moving device.

DETAILED DESCRIPTION

There are many instances involving the discharge of water; for example, from a high dam or the like, in which the discharge needs to be carefully controlled and to be dissipated in such a fashion as not to cause any surrounding difficulty. This is often to atmosphere but is sometimes arranged by effectuating the discharge below the surface of an afterbay or the like.

In the present instance, the form of valve shown in FIG. 1 is arranged to be coupled to a supply pipe 6 having flow therein in the general direction of the arrow 7. The supply pipe 6 is equipped with a peripheral flange 8 as usual, secured by fastenings 9 to the corresponding flange 11 of a mounting tube 12. The tube 12 is preferably circular-cylindrical about an axis 13. The mounting tube 12 extends along the axis to a supporting ring 16. This ring is likewise concentric with the axis 13 and has a circular-cylindrical exterior surface 18.

Forming part of or secured to the mounting tube 12 is a cage 21 extending in an axial direction and having a number of individual fins 22 (conveniently four in number) springing from the mounting tube 12 and extending toward the axis 13 and finally merging with an end plate 23 through a dome configuration 24. The end plate 23 carries a surrounding, supporting band 26 Z-shaped in cross-section and removably secured to the end plate 23 by fasteners 27. The band 26 has a generally circular-cylindrical, interior surface 28.

Concentric with the axis 13 and surrounding the mounting tube 12 is a polyjet tubular sleeve 31 of a generally cylindrical nature. The polyjet sleeve 31 has a reenforcing flange 32 at one end and a reenforcing flange 33 at the other end. Between the flange 32 and an interior rib 34 is a series of openings 36 or ports in number and in position corresponding to the teachings in the above-identified polyjet U.S. Pat. No. 3,605,787.

The polyjet sleeve 31 rests slidingly on the exterior, cylindrical surface of a shoe 38 fastened by bolts 39 to the ring 16. Conveniently, the shoe 38 is made L-shape in cross-section and of good bearing material. A particular seal against the mounting tube 12 is afforded by an O-ring 41 positioned in the ring 16 on the tube 12. There is also an internal seal band 42 abutting the rib 34 and carrying an O-ring 43. The band 42 is fastened in position by a number of radial screws 44.

The supporting band 26 has a group of fastenings 46 securing a packing ring 47 against a series of packings 49 surrounding the exterior of a surface 50 on the supporting band 26. There is an end ring 52 to support the packings 49 and preferably of bronze to ride smoothly against the interior surface of the polyjet sleeve 31. Any leakage between the supporting band 26 and the end plate 23 is precluded by an O-ring 54.

In this fashion the external polyjet sleeve 31 is mounted for free axial translation with respect to the mounting tube 12 by sliding on the shoe 38 as well as on the end ring 52 and the packing 49 and possibly on the packing ring 47.

In order to move the polyjet sleeve 31 relative to the mounting tube 12 in an axial direction, in one instance the end plate 23 supports a disc 61 held in position by fastenings 62 and itself serving as a support for a hydraulic cylinder 63 secured in position by appropriate fasteners 64. A piston rod 66 extends from the hydraulic cylinder and is in engagement with a foot 69 secured in position by fasteners 71 to a spider 72, having substantial open portions, and extending to a rim 73 held by fastenings 74 to the reenforcing flange 33 of the polyjet sleeve. The hydraulic cylinder has a controlled supply and discharge of fluid under pressure, such structures not being shown, as they are standard.

In the operation of this device, when the hydraulic cylinder 63 is supplied with hydraulic fluid under pressure, the piston rod 66 is expelled toward the right hand in the figure and through the spider 72 moves the surrounding polyjet sleeve 31 toward the right. The sleeve 31 slides so that one or more of the openings 36 is brought across the edge of the shoe 38 and is then effective to permit flow from the interior of the mounting tube 12 through such opening or openings 36 and so through the polyjet sleeve 31 to the exterior. A partial opening is shown in FIG. 2. The more the hydraulic piston rod 66 is expelled from the cylinder 63, the more polyjet openings 36 act as conductors from the interior of the mounting tube to the exterior of the polyjet sleeve. Finally, in an extreme position of the hydraulic piston rod 66, the polyjet sleeve is translated entirely to the right in the drawing so that all of the polyjet openings 36 are effective. This is the maximum open position of the valve.

When the hydraulic cylinder is operated in the reverse direction, then the piston rod 66 is retracted or

translated toward the left in the drawing and the polyjet sleeve 31 is moved toward the left, gradually covering or blocking off the polyjet sleeve openings 36. Finally, the parts return to the position shown in FIG. 1 in which all of the openings 36 are covered. There is a seal by the shoe 38 and the O-ring 43 so that in closed position there is substantially no leakage of liquid whatsoever.

This exterior location of the polyjet sleeve is effective to release discharging water through a number of openings and to form a number of jets into the immediate, exterior surroundings. These jets are discharged into the air or into an afterbay below the water surface. They are not then at all disruptive of the surroundings and dissipate the energy of the discharging water quickly. The valve is sometimes provided with a shroud as shown in the above-noted application entitled 'Discharge Valve'.

In the form of the structure shown in FIG. 3, the main arrangement of the device is exactly as described, so similar reference numerals are used. As to the actuating device, however, there is a change. Rather than utilize the cylinder 63 there is preferably provided a plurality of cylinders 81 suitably connected directly or indirectly to the supply pipe 6 in turn secured to the mounting tube 12. The hydraulic cylinders 81 have actuating rods 82 threaded into and locked by nuts 83 adjustably in position in a surrounding flange 84 forming part of the left end of the polyjet sleeve 31. In this instance, instead of having a small reenforcing flange 32, the sleeve 31 rather has a greatly enlarged driving flange 84.

In the operation of this structure the various hydraulic cylinders 81 are supplied with hydraulic fluid under pressure and simultaneously exert force on the actuating rods 82 and so move the polyjet sleeve 31 to the right, for example. This opens the valve by uncovering one or more of the flow passages 36. When the hydraulic connections to the cylinders 81 are reversed, the rods 82 are moved toward the left and retract the polyjet sleeve 31 so that the various sleeve openings 36 are moved out of communication with the interior of the mounting tube 12 and the valve is shut off.

I claim:

1. A valve comprising a mounting tube concentric with an axis, means for supplying one end of said tube with liquid under pressure, a polyjet sleeve having apertures therethrough externally exposed to the atmosphere to discharge said liquid directly to the atmosphere and surrounding and coaxial with said mounting tube, a solid end plate axially spaced from and extending across the other end of said mounting tube, said end plate spanning the interior of said polyjet sleeve, means on said end plate interengaging the interior of said sleeve, an axially extending cage at one end disposed on said mounting tube and disposed along said axis to extend beyond said other end of said mounting tube, means for securing said end plate on said cage, and means interengaging said mounting tube and said polyjet sleeve for moving said polyjet sleeve in axial directions on said mounting tube and across said interengaging means on said end plate.

* * * * *

United States Patent [19]
Dixon

[11] Patent Number: 4,526,192
[45] Date of Patent: Jul. 2, 1985

[54] DISCHARGE VALVE

[75] Inventor: Robert W. Dixon, Concord, Calif.

[73] Assignee: Chas. M. Bailey Co., Inc., Emeryville, Calif.

[21] Appl. No.: 520,650

[22] Filed: Aug. 5, 1983

[51] Int. Cl.³ F16K 3/26; F16K 3/32
[52] U.S. Cl. 137/244; 137/625.3; 137/625.38; 210/430
[58] Field of Search 251/344; 137/625.37, 137/625.38, 625.39, 625.3, 244; 210/429, 430

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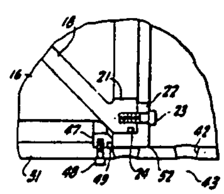
3,605,787	9/1971	Krogfoss et al.	137/625.38 X
4,080,982	3/1978	Maezawa	137/625.3 X

Primary Examiner—Arnold Rosenthal
Attorney, Agent, or Firm—Lothrop & West

[57] ABSTRACT

A discharge valve, especially for liquids, has a tubular body with an inlet and a circumferential outlet. A sleeve is slidable on the body around the outlet and has a large number of holes affording varying flow through the outlet, depending upon the sleeve location. In an extreme or shut-off position of the sleeve, a bearing ring on the body is abutted by a packing ring on the sleeve carrying an O-ring to seal against the bearing ring.

4 Claims, 2 Drawing Figures



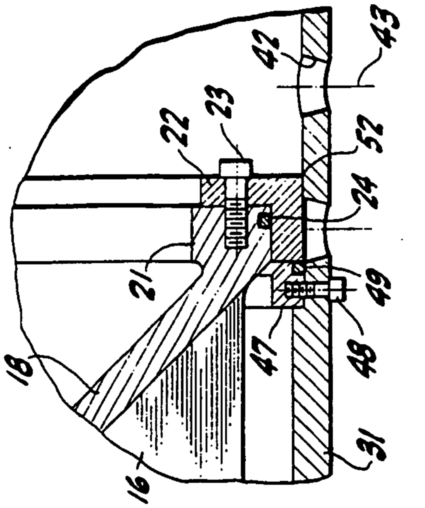


FIG-2

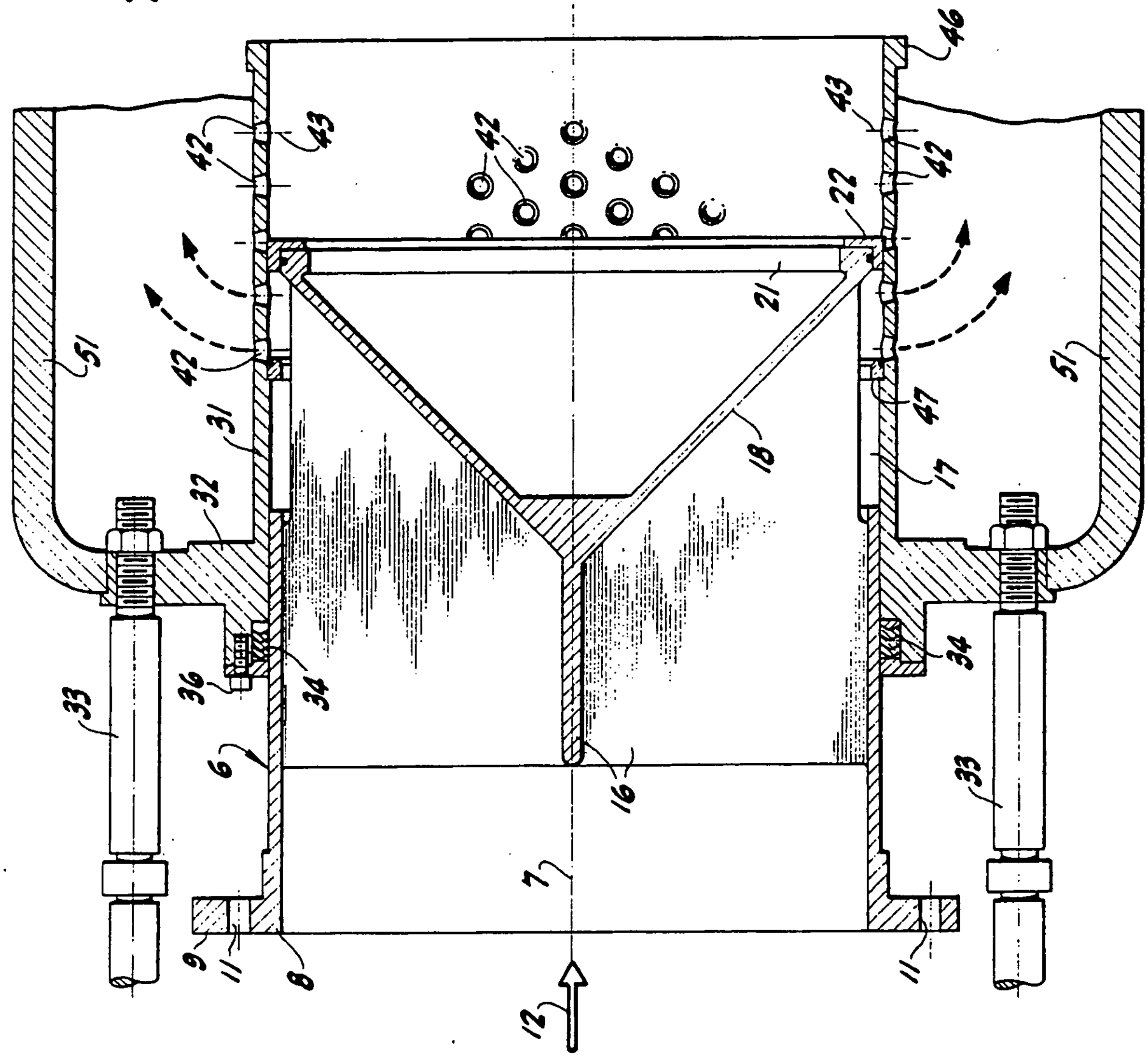


FIG-1

DISCHARGE VALVE

BRIEF SUMMARY OF THE INVENTION

A discharge valve which can be used submersed in a liquid being controlled includes a body symmetrical about a main axis and having a concentric, circular seat. There is an outlet opening between the seat and the remainder of the body. The outlet is more or less covered by a coaxial polyjet sleeve, slidable over the seat and on the body. The sleeve is perforated with a plurality of flow holes, each having an axis substantially normal to the main axis of the body and spaced apart from others of the flow holes. The sleeve moves axially, relative to the body to establish communication between any selected number of the holes and the outlet opening. There is a packing ring on the sleeve. A bearing ring is engaged with the circular seat and is in engagement with the interior of the sleeve and is adapted to abut the packing ring.

PRIOR ART

Particular reference is made to U.S. Pat. No. 3,605,787, issued to Krogfoss and Dixon on Sept. 20, 1971 for a polyjet valve. The present disclosure includes a number of improvements over the basic valve disclosed in that patent.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

FIG. 1 is a cross-section on a vertical, transverse plane through a partly open valve of the invention, being comparable to FIG. 1 in the mentioned patent.

FIG. 2 is a detail showing parts of the valve of FIG. 1 in closed position.

DETAILED DESCRIPTION

Polyjet valves have gone into widespread use, particularly for the control of liquid flow. A main use is to regulate water in hydraulic and hydroelectric projects wherein the discharge of a large quantity of water must be carefully regulated without damage to the environment or to the valve itself. Some special operations have developed collateral problems which it is an object of the present device to overcome. One of the difficulties is that a polyjet valve includes a number of carefully shaped, relatively small orifices through many or all of which the discharging liquid travels. If the liquid is relatively clean, there is no interference with the valve operation. In instances wherein the liquid contains debris of various sorts, it is possible for the debris to catch in or lodge in the various orifices or holes and to tend to block the free axial motion of the valve parts.

In the form of the invention embodied herein, there is provided a valve body 6 of generally circular, cylindrical form symmetrical about a main axis 7 and having an end portion 8 for use in attaching the valve body to a connecting conduit such as a water pipe, there being provided a flange 9 and openings 11 therein for appropriate fastenings. The flow is from the attached line into the main body 6 in the direction indicated by the arrow 12.

The body 6 extends along the axis 7 and is spanned by a plurality of webs or ribs 16 usually four in number, arranged radially about the axis 7 and in part extending to the outer wall 6 of the body, but in some portions stopping short thereof in order to leave an outlet opening 17 peripherally of the body. The webs 16 conveniently merge with a diverting cone 18 coaxially disposed and extending along the axis to terminate in an end seat 21 marking a boundary of the opening 17. The seat 21 is generally circular and is enlarged around its periphery to receive a bearing ring 22 of L-shaped cross-section overlapping two faces of the seat 21 and secured in position by a number of removable fastenings 23. To preclude leakage between the seat and the ring, an O-ring 24 is conveniently provided and is caged between the flange of the seat 21 and the flange of the ring 22. By removing the fastenings 23, the bearing ring can readily be withdrawn axially.

Designed to operate with an axial motion relative to the main body 6 is a polyjet sleeve 31 also of generally circular, cylindrical construction coaxial with the body about the main axis 7. The polyjet sleeve has an outstanding peripheral flange 32 engaged by driving rods 33 detachably secured to the flange and extending to an operating means (not shown), but comparable to the operating means 48 in the indicated patent. The effect of the operating means is to transmit forces through the rods 33 and to move the flange 32 and so to move the polyjet sleeve 31. There is appropriate packing 34 interposed between the body and the sleeve, the packing being of a standard construction, positioned and removed by the use of fastening screws 36.

A portion of the polyjet sleeve is perforated by a large number of special flow holes 42 having their individual axes 43 spaced apart axially and circumferentially as set forth in the indicated patent. The flow holes are preferably tapered with the narrower diameter at the outside of the sleeve and the wider diameter at the inside of the sleeve, so that liquid flowing through the holes from the inside of the sleeve toward the outside tends to be accelerated and to form jets. The sleeve 31 continues past the polyjet flow holes and terminates in an end flange 46. In addition, there is an interior packing ring 47 seated with the polyjet sleeve and disposed in the vicinity of the outlet 17, the packing being fastened in place by radial bolts 48 and including a packing ring or O-ring 49 exposed on its downstream face.

In the operation of the structure and starting from the closed position of the valve as shown in FIG. 2, flow of liquid from the valve is precluded because of the tight seal effectuated by the O-ring 49 between the ring 47 and the adjacent leg of the bearing ring 22.

When the actuating mechanism 33 is operated to the right in FIG. 1, the sleeve is correspondingly translated to the right and positions increasing numbers of the flow holes 42 in communication with the outlet 17. There is released an increasing number of energy dissipating jets flowing to the outside of the sleeve. If desired, these jets can simply dissipate into the surrounding medium, either the atmosphere or water, but in some instances discharge into the interior of a shroud 51, shown broken away but extending from the flange 32 and customarily extending as far as desired to intercept the issuing jets.

In any proper case, there is substantial liquid discharge through the flow openings, but in the event there should be blockage of some or more of the holes by debris in the fluid, then in the present case it is only necessary to retract the sleeve toward its closed position. In this event debris projecting inwardly toward the axis and through any one or more of the flow holes is carried with the sleeve to the left in FIG. 1. The debris encounters an abrupt or sharp peripheral corner

or rim 52 on the bearing ring 22. The abrupt corner of the bearing ring acts in conjunction with the edge of the flow holes (even though such edge may be slightly rounded) as a shear and tends to cut or macerate any projecting debris. In this way the debris is either dislodged or cut sufficiently so that it can flow out with the ensuing discharging jet and clear the openings.

It has been found in practice that when there is a clogging of one or more of the various polyjet openings, it is only necessary to translate the sleeve with respect to the body in a part of a cycle or a full cycle or through several cycles in order to relieve the openings of their obstructions.

I claim:

1. A submersible discharge valve comprising a body symmetrical about a main axis and having an inlet on said main axis, a coaxial circular seat, means for mounting said seat on the end of said body, means defining a radial outlet opening in said body between said inlet and said seat, a coaxial polyjet sleeve mounted to slide over said seat and on said body, said sleeve being perforated with a plurality of radial flow holes, each of said flow holes having a radial axis and being spaced axially from others of said flow holes, means for moving said sleeve axially relative to said body to establish communication between a selected number of said flow holes and said opening, packing means on said sleeve in sliding engagement with said body, and a peripheral bearing ring removably mounted on said circular seat and in sliding engagement with the interior of said sleeve and across said flow holes.

2. A valve as in claim 1 in which said bearing ring has an abrupt edge adapted to act with the margin of said holes as a shear for matter projecting through said holes.

3. A valve as in claim 1 including a stop ring on the interior periphery of said sleeve and having a transverse face adapted to abut said bearing ring.

4. A valve as in claim 3 including a peripheral seal on said transverse face of said stop ring adapted to abut said bearing ring.

* * * * *

United States Patent [19]

Carl et al.

[11] Patent Number: 4,552,174

[45] Date of Patent: Nov. 12, 1985

[54] SPRING-LOADED CHECK VALVE

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[73] Assignee: ITT Corporation, New York, N.Y.

[21] Appl. No.: 656,120

[22] Filed: Sep. 28, 1984

[51] Int. Cl.⁴ F16K 15/03

[52] U.S. Cl. 137/527.2; 251/303; 251/337

[58] Field of Search 137/527, 527.2; 251/75, 251/336, 337, 303

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Primary Examiner—Alan Cohan
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[57] ABSTRACT

A check valve particularly for use in large-volume applications includes a self-contained pressing unit which is mounted on a common pivot with the valve member in the outlet compartment of the valve housing and presses the valve member towards its closing position in which it sealingly contacts the valve seat. The pressing unit includes an elongated support member and an L-shaped pressing member which are mounted on a bearing sleeve for angular displacement relative to one another about the axis of the bearing sleeve. A buckling-type spring is mounted between a free end portion of the support element and the region of merger of the two legs of the L-shaped pressing member, the spring urging the pressing component away from the support component, and against the valve member upon installation on the pivot. The spring characteristic is such that the spring force initially rapidly increases, than drops precipitously and then remains substantially constant over a substantial range of deformation of the spring. The pressing unit is self-contained even when located outside the valve housing and can be introduced into the outlet compartment through an access opening.

13 Claims, 5 Drawing Figures

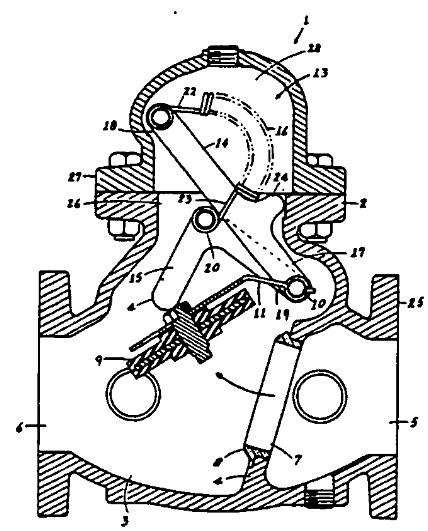


FIG. 1

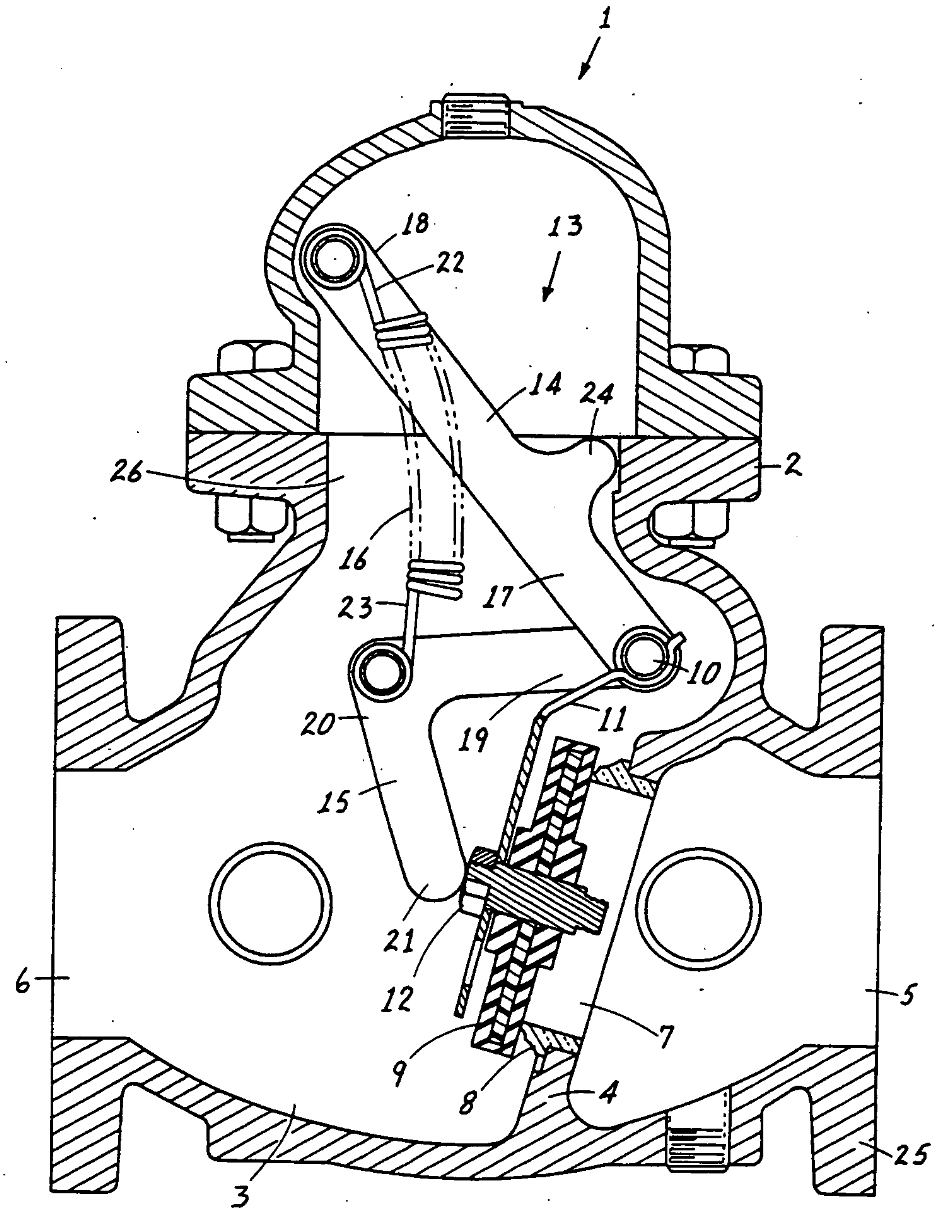


Fig. 2

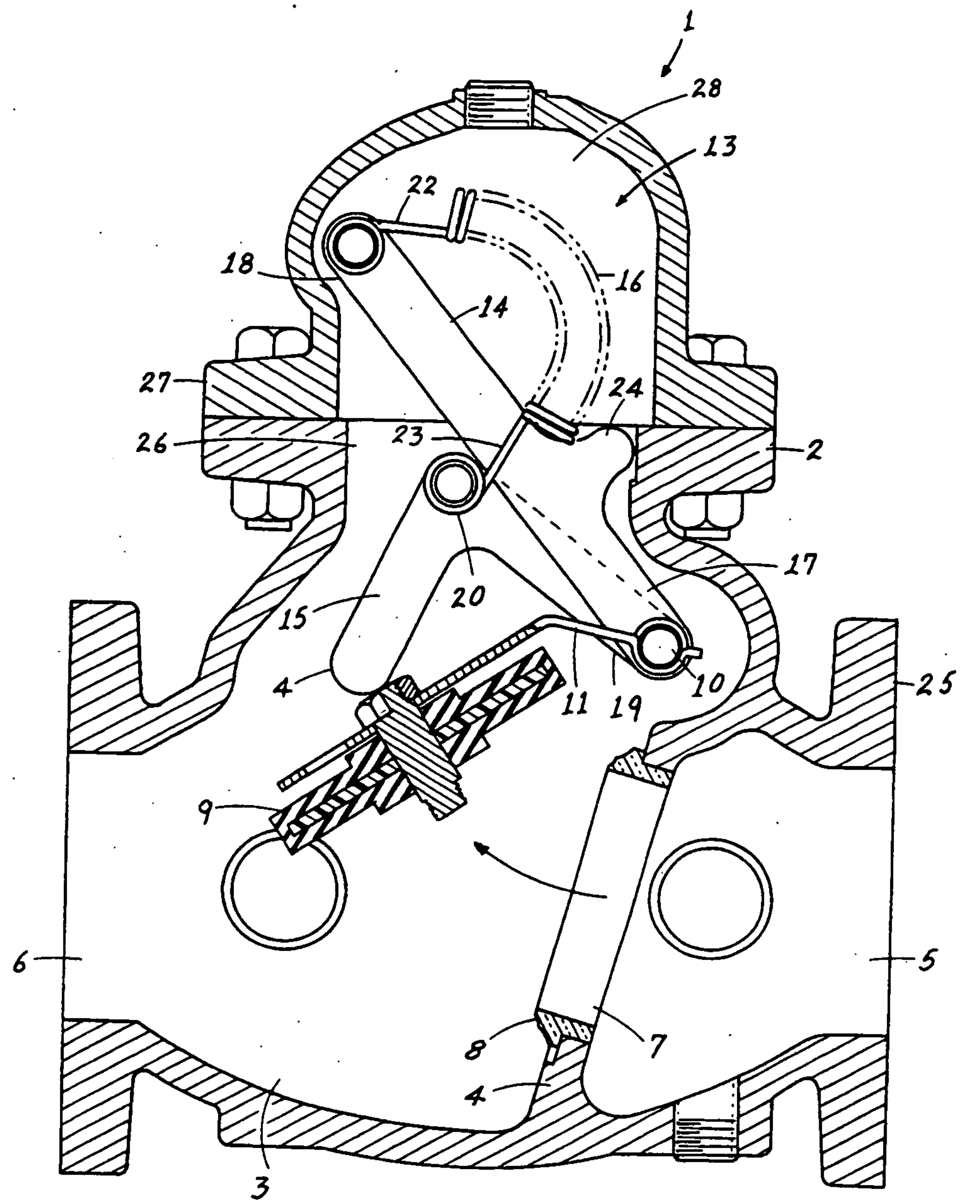
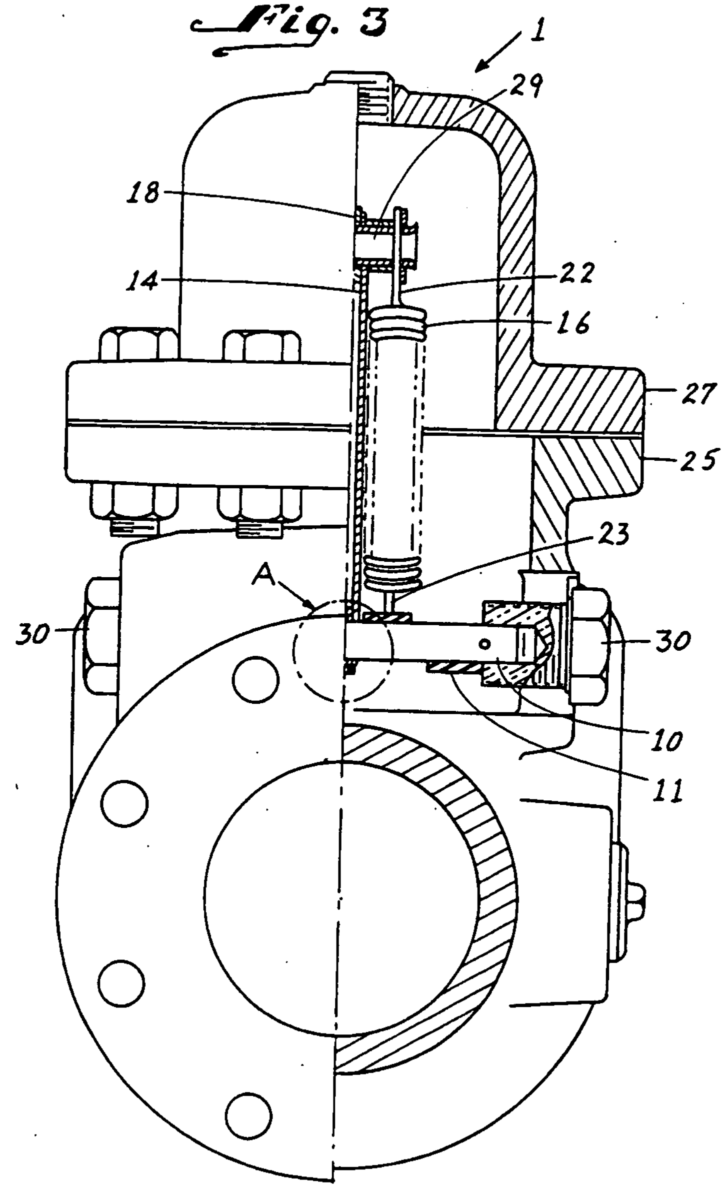


Fig. 3



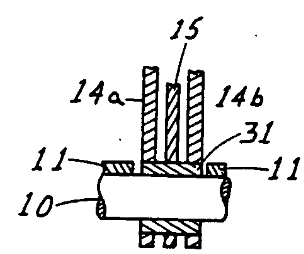
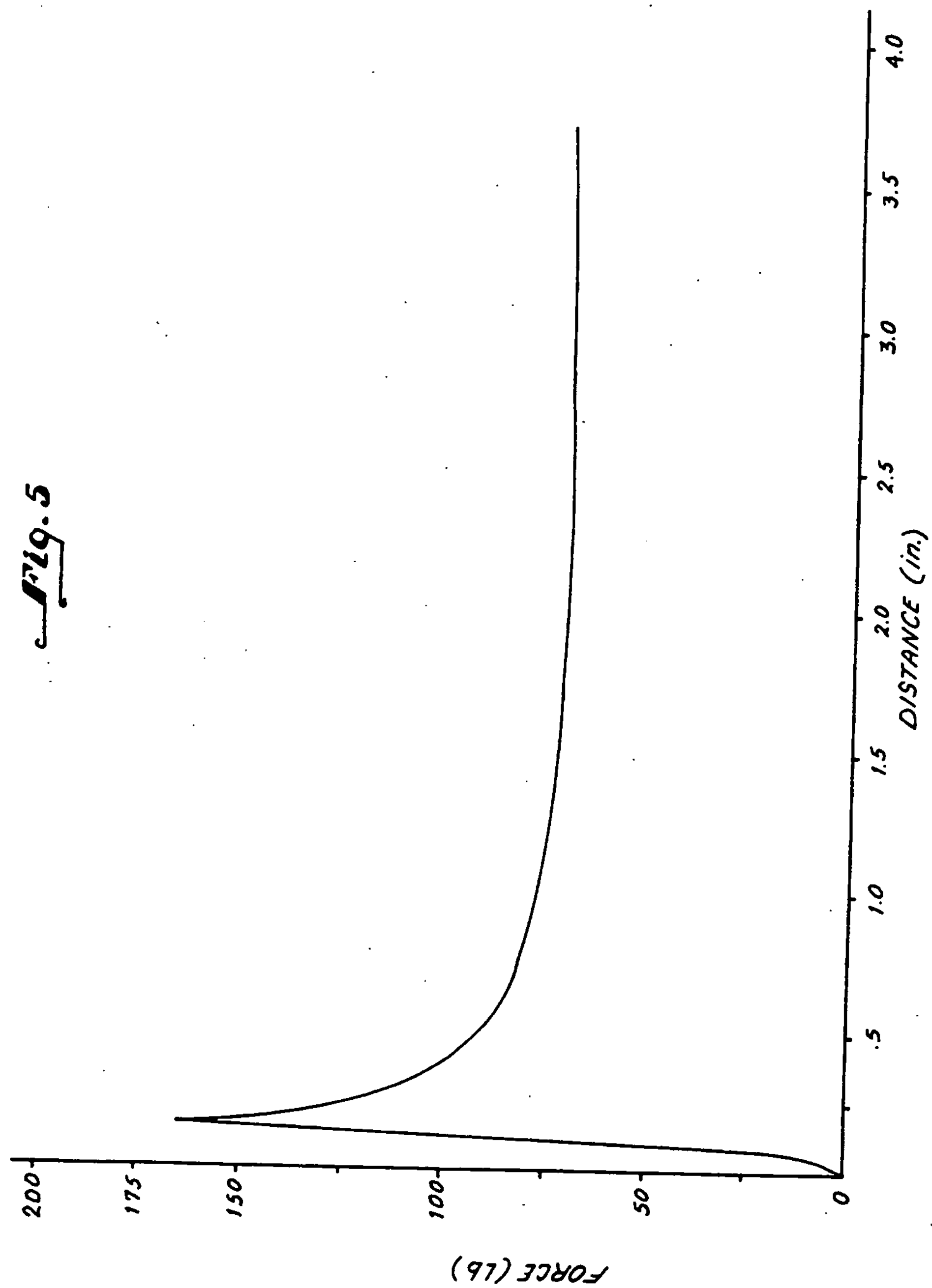


Fig. 4

FIG. 5



SPRING-LOADED CHECK VALVE

BACKGROUND OF THE INVENTION

The present invention relates generally to spring-loaded check valves, and more particularly to a check valve loaded by a spring having a substantially constant spring force over a considerable range of its deformation.

There are already known various constructions of check valves which are constructed to permit flow of a fluid therethrough in one direction but to prevent such flow in the opposite direction. To keep the valve member in its closing position until and unless the pressure exceeds the outlet pressure by a predetermined margin, it is already known to use springs or weights which act on the valve member and urge the same toward sealing contact with a valve seat provided in the interior of the valve housing. So, for instance, it was already proposed to use a buckling-type helical spring for this purpose, one end of such a spring being connected to the valve member which is pivotaly mounted in the outlet compartment of the valve housing, while the other end of the spring is secured to a region of the valve housing which is spaced at predetermined distance from the valve member. However, experience with this kind of an arrangement has shown that it is quite difficult to assemble the valve of this construction, inasmuch as the spring has to be pretensioned as it is being mounted in the outlet compartment of the valve housing to assure that the valve member will engage the valve seat with a sufficient amount of force to avoid leakage of fluid past the valve member. It is also already known to use spring-loaded 4-bar linkages for urging the valve member against the valve seat; yet, even such constructions have been proven to be less than satisfactory in terms of operation and particularly ease of assembly.

SUMMARY OF THE INVENTION

Accordingly, it is a general object of the present invention to avoid the disadvantages of the prior art.

More particularly, it is an object of the present invention to provide a check valve of the type here under consideration which does not possess the disadvantages of the known check valves of this type.

Still another object of the present invention is so to construct the check valve as to facilitate the assembly thereof, to make it unneccessary to pre-tension the spring while the latter is already received in the outlet compartment, and to minimize the resistance which the valve member offers to the flow of the fluid through the interior of the housing in the one direction when the valve member is in its open position.

A concommitant object of the present invention is so to design the check valve of the above type as to be simple in construction, inexpensive to manufacture, easy to use and reliable in operation nevertheless.

In pursuance of these objects and others which will become apparent hereafter, one feature of the present invention resides in an arrangment for urging a check valve member which is mounted in an outlet compartment of a valve housing for pivoting about an axis of a pivot between a closing position in which its sealingly contacts, and an open position in which it is remote from, a valve seat provided in the valve housing, toward the closing position, this arrangment comprising a support component having a mounting portion, a support portion situated remotely from the mounting portion and in use behind the valve member as considered in the direction toward the open position, and a contact portion; a pressing component having a first portion, a second portion situated remotely from the first portion and in use between the valve member and the support portion of the support component, and a third portion arranged in use to contact a predetermined area of the valve member; a buckling-type helical spring including one end portion secured to the support portion of the support component and another end portion secured to the second portion of the pressing component; and means for mounting the support and second portions on one another for relative angular displacement about an axis for the components to form a self-contained unit with the spring, the mounting and first portions also being mounted in use on the pivot with the axes in substantial coincidence for the spring to urge the contact portion of the support component against the housing and the third portion of the pressing component toward contact with the predetermined area of the valve member. The present invention is also directed to a check valve which incorporates the above-discussed urging arrangement.

A particular advantage of the above-discussed construction is that the self-contained unit including the support and pressing components and the spring can be assembled outside the housing and the spring can be pre-tensioned prior to the introduction of the self-contained unit into the outlet compartment of the housing and temporarily maintained in its pre-tensioned condition until after the unit is mounted on the pivot which simultaneously supports the valve member, whereupon it is merely necessary to discontinue the temporary pre-tensioning action for the spring to apply its pre-tensioning force via the third portion of the pressing component to the valve member to press the latter with the desired force against the valve seat. Another advantage is that no special mounting portions need be provided in the housing for the connection of the spring thereto. Moreover, the components of the self-contained unit can be manufactured very easily and connected to one another in a very simple fashion, thus keeping the cost of manufacture of the valve to a minimum.

BRIEF DESCRIPTION OF THE DRAWING

Above-mentioned and other features and objects of this invention will become more apparent by reference to the following description taken in conjuncton with the accompanying drawings, in which

FIG. 1 is a longitudinal sectional view of a check valve according to the present invention in its closing codition;

FIG. 2 is a view similar to FIG. 1, but with the check valve in its open position;

FIG. 3 is a partially cross-sectioned end view of the valve invention and the closed position of FIG. 1; and

FIG. 4 is an enlarged sectional view of area A of FIG. 3; and

FIG. 5 is a diagrammatic representation of the dependence of the spring force on spring deformation.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawing in detail, and first to FIG. 1 thereof, it may be seen that the reference numeral 1 has been used to identify a check valve constructed in accordance with the present invention, in its

entirety. The check valve 1 includes a housing 2 which bounds an internal space 3. The housing 2 includes an internal partitioning wall 4 which subdivides the internal space 3 into an inlet compartment 5 and an outlet compartment 6. The partitioning wall or portion 4 is provided with a passage 7 which establishes communication between the inlet compartment 5 and the outlet compartment 6. A valve seat 8 surrounds the passage 7 at least on the side of the outlet compartment 6.

The flow of fluid between the inlet compartment 5 and the outlet compartment 6 through the passage 7 is controlled by a valve member 9 which is mounted on a pivot 10 supported on the housing 2 for pivoting about an axis of the pivot 10, this pivot axis being substantially parallel to the plane of the valve seat 8 and being off-set said along such plane from the passage 7. The mounting of the valve member 9 on the pivot 10 is accomplished by a hinge 11, to which the valve member 9 is connected by means of a fastener 12 shown to be constructed as a bolt.

In FIG. 1, the valve member 9 is shown in its closing position in which it sealingly contacts the valve seat 8 and hence prevents flow of fluid between the compartments 5 and 6, so long as the pressure prevailing in the inlet compartment 5 does not considerably exceed the pressure prevailing in the outlet compartment 6.

The valve member 9 is held in its closing position of FIG. 1 by a spring-loaded pressing mechanism or unit designated in its entirety by the reference numeral 13. The pressing unit 13 includes two main components 14 and 15 and a spring 16. The component 14, which will hereinafter be referred to as the support component, is elongated, that is, it extends along a substantially straight course between its mounting portion 17 and its support portion 18. The mounting portion 17 is mounted, in a manner yet to be described, on the pivot 10. The component 15 extends along a substantially L-shaped course, that is, it has a shape which resembles that of a bell crank lever. This component 15, which will be called a pressing component, includes a first portion 19 which is mounted for pivoting about the axis of the pivot 10, a second portion 20 at which the two arms of the L-shaped pressing component 15 come together, and a third portion 21 which engages the valve member assembly 9, 11 and 12 and particularly the bolt 12 thereof. The spring 16 has two end portions 22 and 23 which are respectively secured to the support portion 18 of the support component 14, and to the second portion 20 of the pressing component 15. The spring 16 is of a known construction such as that manufactured by Ameteck-Hunter Spring of Hatfield, Pa. under the trade name Flexator. In the spring 16 of this construction, the end portions 22 and 23 are both situated at the same side of the spring 16 which is of a helical configuration between the end portions 22 and 23. Because of this construction, when compression forces are applied to the spring 16, the eccentric arrangement of the end portions 22 and 23, in conjunction with a slight degree of buckling imparted to the spring 16 during the assembly of the unit 13 and retained in the position of FIG. 1, will cause the spring 16 to increase the degree of its buckling, as will become apparent from the comparison of FIG. 2 with FIG. 1. In addition to facilitating the further buckling, the relatively small degree of buckling evident from FIG. 1 has another purpose, namely, that of urging the portions 18 and 20 apart. More particularly, the longitudinal axis of the spring 16 extends along a substantially straight course in the relaxed condition of the spring 16, so that the spring 16 must be prestressed for it to extend along the arcuate course illustrated in FIG. 1. As will be explained in more detail later, this initial pre-stressing or pre-tensioning causes the pressing element 15 to urge the valve member 9 against the valve seat 8 with a predetermined force to maintain the valve member 9 in sealing contact with the valve seat 8 so long as the pressure in the inlet compartment 5 is the same as in the outlet compartment 6 or exceeds the pressure in the outlet compartment 6 by less than a predetermined amount.

To maintain the support element 14 in position, that is, to prevent displacement or yielding of the support element 14 under the influence of the force of the spring 15 thereon, the support element 14 is provided with a transversely extending contact portion 24 which is pushed by the force of the spring 16 into abutment with the housing 2, once the unit 13 is introduced into the housing 2. Of course, the force of the spring 16 also prevents the support element 14 from moving in the opposite direction. Hence, once the unit 13 is installed in the housing 2, the support element 14 remains stationary while the spring 16 presses the pressing component 15 against the valve member assembly 9, 11 and 12. On the other hand, when the pressure in the inlet compartment 5 exceeds the pressure in the outlet compartment 6 by a predetermined amount, the resistance force of the spring 16 to deformation is overcome, and the valve member 9 is caused to move away from the valve seat 8, with attendant displacement of the pressing component 15 towards its open position illustrated in FIG. 2. Of course, the extent of displacement of the valve member 9 will depend on the force of the fluid acting on the valve member 9 and on the resistance force exerted by the spring 16.

The housing 2 includes a main portion 25 which bounds the inlet and outlet compartments 5 and 6 and also an access opening 26 which communicates with the outlet compartment 6 or forms a part thereof, and an auxiliary portion 27 of a substantially dome-shaped configuration which is connected to the main portion 25, spans the opening 26 and bounds an internal cavity 28. The support component 14 extends into the cavity 28, and so does the spring 16. The dimensions of the unit 13 are such that the unit 13 can be introduced into the outlet compartment 6 through the access opening 26, and/or removed from the outlet compartment 6 through such opening 26.

FIG. 3 shows that the end 22 of the spring 16 is connected to the support portion 18 of the support component 14 by being mounted on a pin-shaped or sleeve-shaped element 29 which is secured to the support portion 18. The end 23 of the spring 16 is connected to the second portion 20 of the pressing component 15 in a similar or identical manner, but this has been omitted from the drawing for the sake of clarity. FIG. 3 of the drawing also shows that the pivot 10 is mounted on the main portion 25 of the housing by means of plug-shaped end bearing elements 30 which are threadingly received in appropriate threaded bores of the housing 2 and which have respective recesses that receive the end portions of the pivot 10. It is also shown there how the hinge 11, which is of a conventional construction, is mounted on the pivot 10 and that the support component 14 is arranged at the central region of the valve 1. Another spring 23 is preferably arranged at the opposite side of the unit 13 substantially symmetrically to the illustrated sping 23.

FIG. 4 shows that the support component 14 includes two separate support elements 14*a* and 14*b* of substantially identical configuration which are spaced from one another in the axial direction of the pivot 10, while the pressing component 16 is disposed between the elements 14*a* and 14*b*. The elements 14*a* and 14*b* and the component 15, rather than being mounted directly on the pivot 10, are mounted on an intermediate sleeve 31 which accommodates a portion of the pivot 10. The intermediate sleeve or bearing 31 is advantageously so dimensioned as to be received with interference fit in corresponding holes of the elements 14*a* and 14*b*, while the pressing component 15 is mounted on the bearing 31 for pivoting about this axis of the latter which, in the assembled condition, coincides with the axis of the pivot 10. Because of the above-mentioned interference fits of the bearing 31 in the holes of the elements 14*a* and 14*b*, the unit 13 is joined at this area even in the absence of the pivot 10, that is, even when the unit 13 is located outside the housing 2, so that the unit 13 is self-contained.

Finally, FIG. 5 shows the spring characteristic of the spring 16, that is, the dependence of the resistance force exerted by the spring 16 on the deformation of the spring 16. It may be seen that the spring force increases rapidly with increasing deformation or distance, this being the area of pretensioning of the spring 16. The spring force drops precipitously afterward (this corresponds to the initial opening of the valve), whereupon the spring force remains substantially constant over considerable distance. This means that, once the valve member 9 is displaced to a relatively small extent away from the valve seat 8, the further displacement of the valve member 9 towards its fully open position of FIG. 2 in which it is situated substantially out of the way of the main flow of the fluid through the valve 1 takes relatively little effort.

Such a valve can find advantageous use in waterworks and in fire protection service. A check valve of this type usually requires special characteristics. It is necessary that it remain closed to the passage of fluid in the normal direction of flow until the pressure at the inlet is, for example 1 to 3 psi above the outlet pressure. When the inlet pressure exceeds the opening pressure threshold (which is also referred to as "cracking" or "breaking" pressure) the valve expected to open fully and to present little impediment to fluid flow. A check valve of this type is also expected to present an effective barrier to the flow of fluid in the reverse direction.

Very often, such detector check valves are installed in fire protection lines. Under such circumstances, it is not desirable to meter the water flowing through the fire protection lines, since ordinarily there would be no water usage in such lines. The reason for this is that large water meters are very expensive and also impede the flow of water in the event of a fire. On the other hand, water purveyors wish to know if water is being pilfered for non-fire protection purposes. In this installation, the detector check valve has a very small meter installed in a line bypassing the seat of the valve. When the inlet pressure exceeds the outlet pressure by a measurable amount, small amounts of water pass through the meter and thus flow is detected. If the pressure drop is significant, the valve is opened and presents little or no obstruction to the flow necessary for fighting fires. It may be seen from the above description that the check valve 1 constructed according to the present invention is ideal for these purposes or applications since it satisfies all of the criteria expected to be satisfied by the check valve. Furthermore, this valve may also be advantageously used in applications where it is desired to deal with the water hammer effect.

While we have described above the principles of our invention in connection with specific apparatus, it is to be clearly understood that this description is made only by way of example and not as a limitation to the scope of our invention as set forth in the objects thereof and in the accompanying claims.

We claim:

1. A check valve comprising
   - a housing bounding an internal space and including a partitioning portion that subdivides said internal space into an inlet compartment and an outlet compartment and has a communicating passage therein and a valve seat thereon which extends around said passage and along a valve seat plane;
   - a supporting pivot mounted in said outlet compartment and having a pivot axis extending parallel to said plane and offset along said plane from said passage;
   - a valve member mounted on said pivot for pivoting about said pivot axis between a closing position in which it sealingly contacts said valve seat, and an open position in which it is remote from the latter;
   - a support component having a mounting portion mounted on said pivot, a support portion situated remotely from said pivot behind said valve member as considered in the direction toward said open position, and a contact portion;
   - a pressing component having a first portion mounted on said pivot for pivoting about said pivot axis, a second portion situated remotely from said pivot between said valve member and said support portion of said support component, and a third portion arranged to contact a predetermined area of said valve member; and
   - a buckling-type helical spring including one end portion secured to said support portion of said support component and another end portion secured to said second portion of said pressing component for said spring to urge said contact portion of said support component against said housing and said third portion of said pressing component toward contact with said predetermined area of said valve member.

2. The check valve as defined in claim 1, wherein said housing includes a main portion having an access opening that opens into said outlet compartment, and an auxiliary portion detachably connected to said main portion in a position in which it extends across said access opening and sealingly separates the latter from the exterior of said housing.

3. The check valve as defined in claim 2, wherein said access opening is dimensioned to permit passage of at least said valve member, said support and pressing components, and said spring therethrough between the exterior of said main portion of said housing and said outlet compartment.

4. The check valve as defined in claim 3, wherein said support and pressing components and said spring are joined together to form a self-contained unit even when situated outside said housing; wherein said access opening is dimensioned to permit the passage of said self-contained unit therethrough; and wherein said pivot mounts said valve member and said self-contained unit

in said outlet compartment after introduction thereof into the latter through said access opening.

5. The check valve as defined in claim 2, wherein said auxiliary portion bounds a cavity which opens into said access opening in said position and wherein said support portion of said support component extends into said cavity.

6. The check valve as defined in claim 1, wherein said support component extends along a substantially straight course from said mounting portion to said support portion thereof; and wherein said contact portion extends transversely of said course intermediate said mounting and support portions.

7. The check valve as defined in claim 1, wherein said pressing component extends along a substantially L-shaped course between said first and said third portions thereof, said second portion being situated at the region of merger of the two legs of the L-shaped course.

8. The check valve as defined in claim 1, wherein the spring is of the type in which the resistance force thereof to deformation initially rapidly increases, then rapidly drops to a predetermined level, and then remains substantially at the predetermined level, with increasing deformation.

9. An arrangement for urging a check valve member mounted in an outlet compartment of a valve housing for pivoting about an axis of a pivot between a closing position in which it sealingly contacts, and an open position in which it is remote from, a valve seal provided in the valve housing, toward said closing position, said arrangement comprising

- a support component having a mounting portion, a support portion situated remotely from said mounting portion and in use behind said valve member as considered in the direction toward said open position, and a contact portion;
- a pressing component having a first portion, a second portion situated remotely from said first portion and in use between said valve member and said support portion of said support component, and a third portion arranged in use to contact a predetermined area of said valve member;
- a buckling-type helical spring including one end portion secured to said support portion of said support component and another end portion secured to said second portion of said pressing component; and
- means for mounting said support and second portions on one another for relative angular displacement about an axis for said components to form a self-contained unit with said spring, said mounting and first portions also being mounted in use on said pivot with said axes in substantial coincidence for said spring to urge said contact portion of said support component against said housing and said third portion of said pressing component toward contact with said predetermined area of said valve member.

10. The arrangement as defined in claim 9, wherein said support component extends along a substantially straight course from said mounting portion to said support portion thereof; and wherein said contact portion extends transversely of said course intermediate said mounting and support portions.

11. The arrangement as defined in claim 9, wherein said pressing component extends along a substantially L-shaped course between said first and said third portions thereof, said second portion being situated at the region of merger of the two legs of the L-shaped course.

12. The arrangement as defined in claim 9, wherein the spring is of the type in which the resistance force thereof to deformation initially rapidly increases, then rapidly drops to a predetermined level, and then remains substantially at the predetermined level, with increasing deformation.

13. The arrangement as defined in claim 9 wherein said mounting means includes a mounting sleeve passing through said member and first positions and having an internal bore for receiving a portion of said pivot to mount said unit on the latter.

* * * * *

United States Patent [19]
Banks

[11] Patent Number: 4,595,032
[45] Date of Patent: Jun. 17, 1986

[54] VALVE CLOSING DEVICE

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[73] Assignee: John Valves Pty., Ltd., Ballarat, Australia

[21] Appl. No.: 579,991

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[30] Foreign Application Priority Data

Feb. 25, 1983 [AU] Australia PF8204

[51] Int. Cl.[4] F16K 15/03; F16K 31/56
[52] U.S. Cl. 137/527; 251/75
[58] Field of Search 137/418, 527, 527.2, 137/527.4, 527.6; 251/75

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[57] ABSTRACT

A valve closure is disclosed which comprises a bifurcated arm 14 pivotally coupled to a sleeve 34 by a connector 28 and a pivot pin 26. The sleeve 34 receives a rod 44 coupled to a base plate 46 for receiving a spring 42. The sleeve 34 also has a support plate 38 coupled thereto which receives the spring 42. When the valve element is in an open position the arm 14, sleeve 34 and rod 44 are a generally straight line so that the spring does not exert any torque on the valve element. However, when the valve element commences to close the arm 14 is moved relative to the sleeve 34 and the rod 44 so that the spring 42 causes torque to be exerted through the arm to assist closure of the valve element. In a second embodiment a tension spring 104 is provided which acts on lever 106 pivotally connected to a closure arm 108.

18 Claims, 6 Drawing Figures

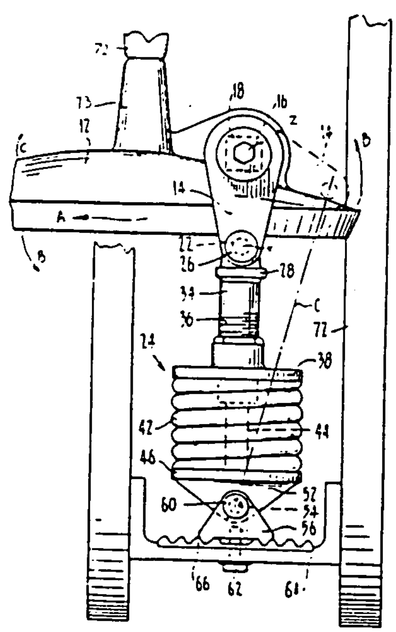
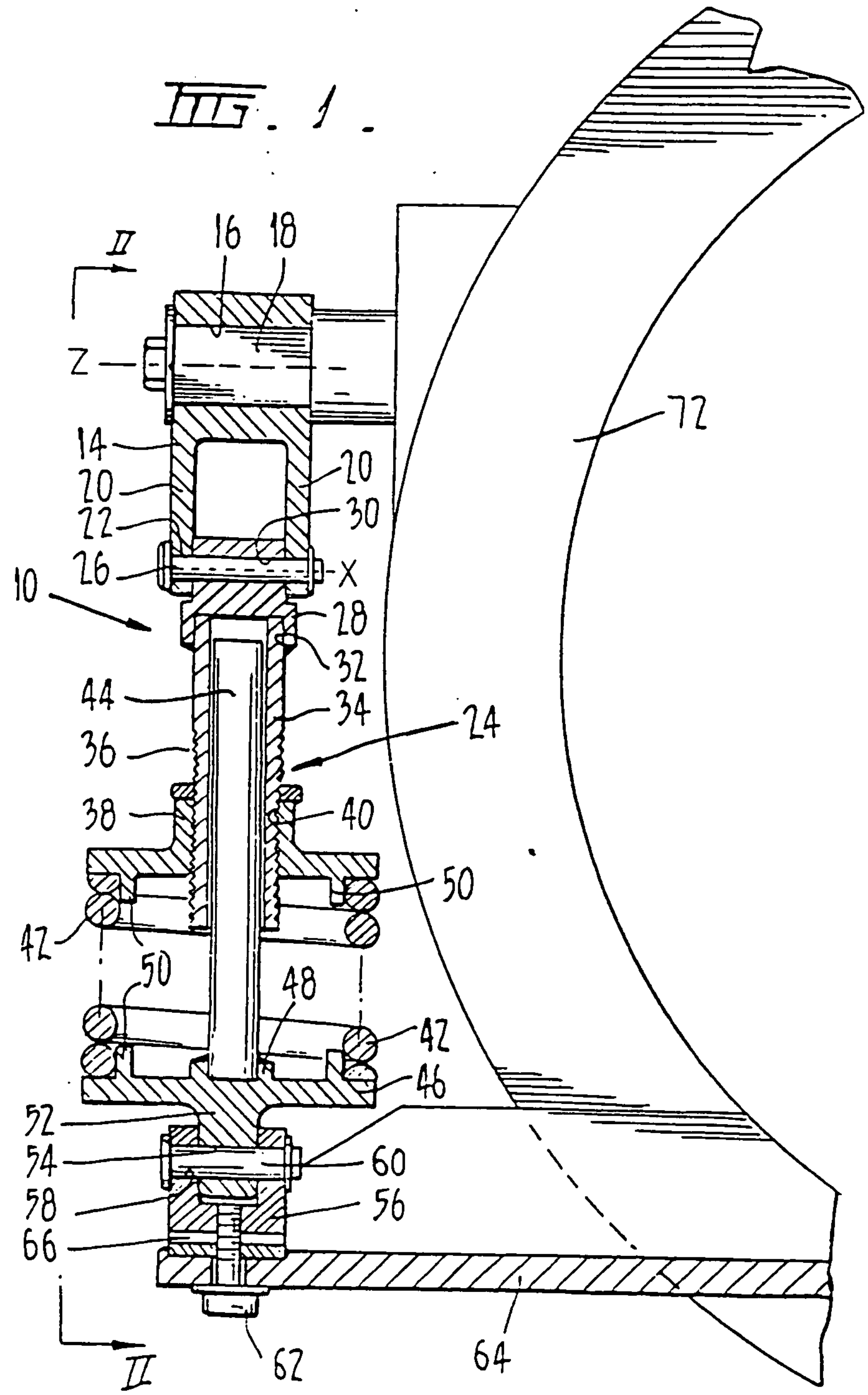


FIG. 1.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16
18
Z
72
14
20
20
22
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X
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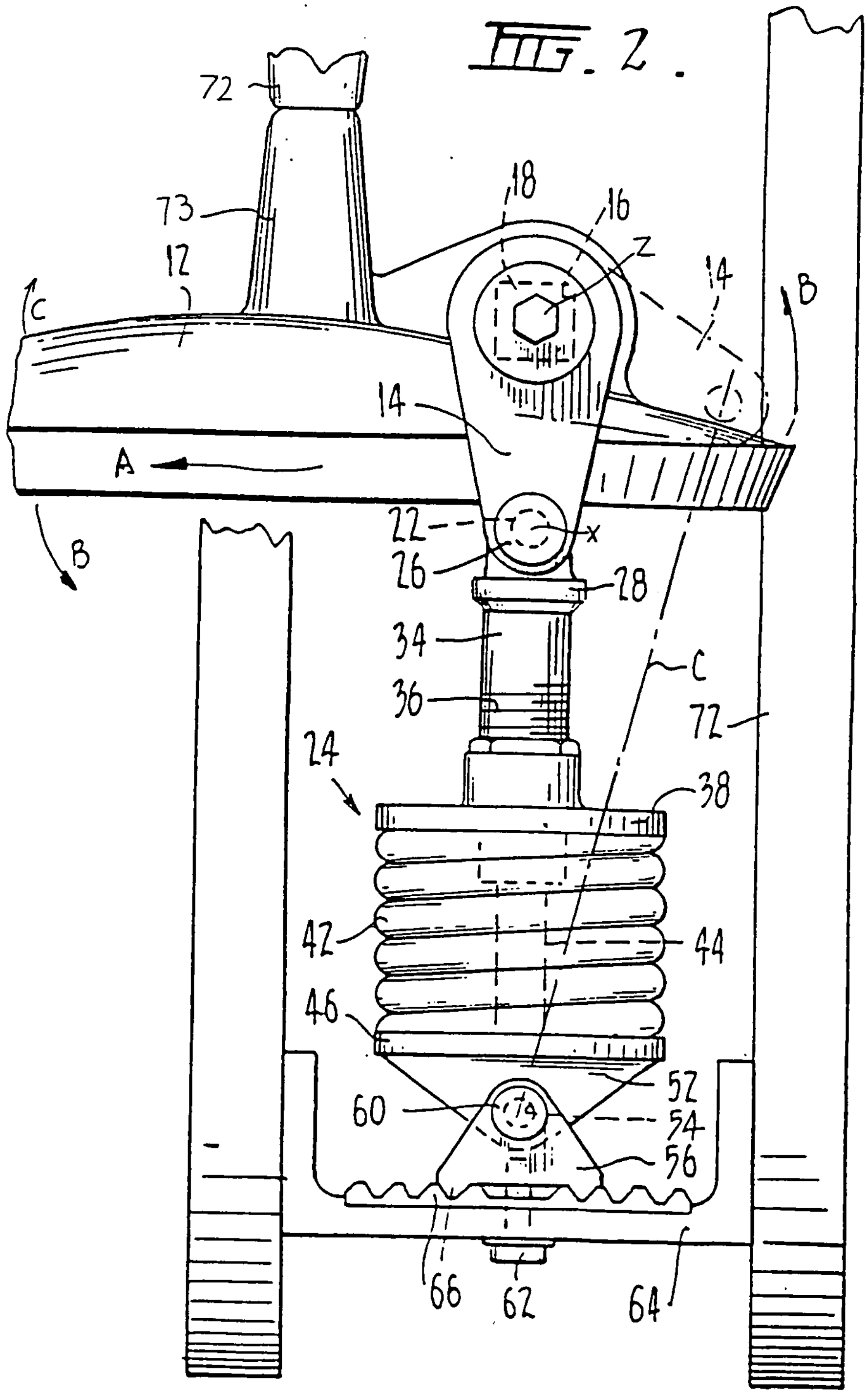
56
66
62
64
II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C
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B
14
A
B
22
X
26
28
34
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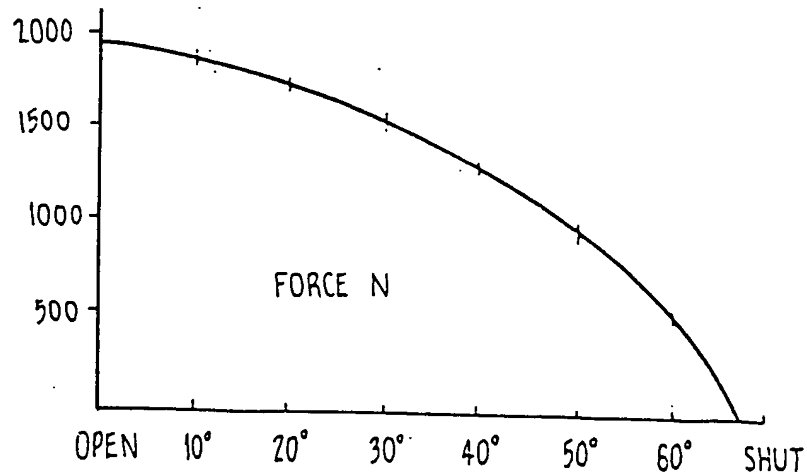
C
72
24
38
42
44
46
52
60
74
54
56
66
62
64

FIG. 2.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1500
1000
500
FORCE N
OPEN
10°
20°
30°
40°
50°
60°
SHUT

FIG. 3A.

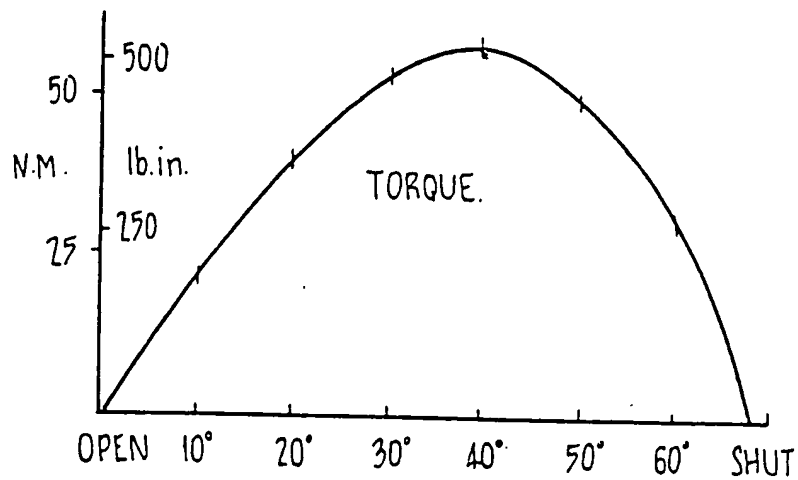
500
50
N.M.
lb.in.
TORQUE.
250
25
OPEN
10°
20°
30°
40°
50°
60°
SHUT

FIG. 3B.

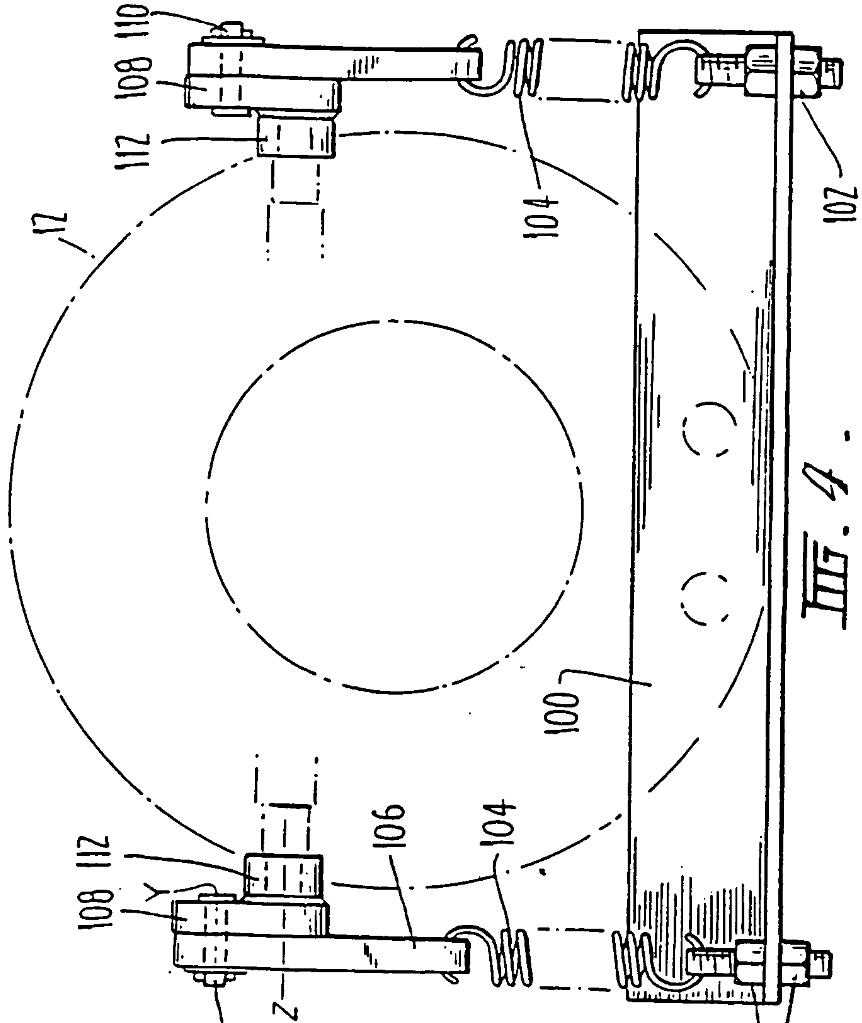
110
108
112
12
104
102
100
106
Y
Z

FIG. 4.

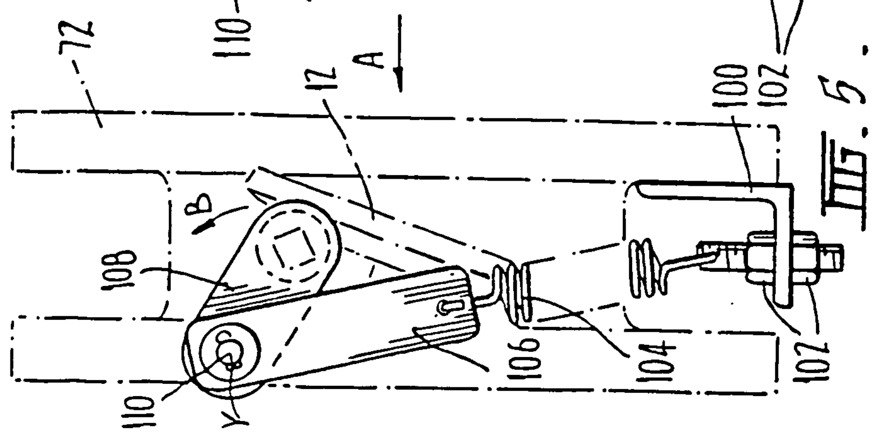
72
A
12
B
108
110
Y
106
104
100
102

FIG. 5.

VALVE CLOSING DEVICE

This invention relates to a device for assisting closure of a valve element and in particular to a device for assisting closure of a disc of a tilting disc valve or swing check type.

Tilting disc valves include a disc for regulating flow of a liquid through the valve and may have an external mechanism to assist the disc to close. Usually tilting disc valves are used in a conduit in conjunction with a pump or the like which is upstream of the valve. The purpose of the valve is to close the conduit if the pump fails or for other reasons liquid pressure in the conduit drops to prevent backflow through the valve and into the pump.

The mechanism which may be utilised to assist the valve disc to close is usually in the form of a lever and weight which is connected to the disc. When the valve is open the disc is generally horizontal and parallel to the direction of liquid flow through the valve. The flow of fluid past the disc produces a torque which is required to maintain the disc in the open position and counteract the torque generated by any external weight. When the moment of the disc, weight and lever is greater that the torque produced by the fluid flow through the valve, the disc closes by pivoting about a shaft. Accordingly once the flow rate through the valve drops due to failure of the pump or the like, the weight of the disc and the lever and weight causes the disc to rotate into a closed position.

However in the above tilting disc valves the time taken for the disc to close the valve against the reduced pressure of the liquid in the valve is not always quick enough to prevent some backflow through the valve. If backflow does pass through the valve it can damage the pump and also damage the valve itself by slamming the disc against the valve body.

Further, because the flow of fluid through the valve is required to maintain the disc in the open position and the lever and weight in the upper position dynamic fluid forces always act on the disc which results in a pressure loss through the valve.

The object of this invention is to overcome the above drawbacks.

The present invention may therefore be said to reside in a device for assisting closure of a valve element, said device comprising a closure member coupled to said valve element, and biasing means coupled for relative movement to the closure member, such that when the valve element is in an open position the closure member and biasing means are in a generally straight line and when the valve element commences to close the closure member is moved relative to the biasing means so torque is exerted by the biasing means through the closure member to assist closure of the valve.

Accordingly since closure of the valve element is assisted by torque imparted to the disc by the biasing means the element closes quickly to prevent backflow through the valve and since the closure member and biasing means are in a straight line when the element is open the force of the biasing means does not cause any torque to be imparted to the element and the flow through the valve need only maintain the element itself in the open position. Hence pressure loss through the valve when in the open position is greatly reduced.

Preferably the element is a disc and the closure member is an arm coupled to the disc by a shaft by means of a square section, pin or key so that it cannot turn relative to the arm.

Preferably the biasing means includes a coil spring retained between a pair of plates which are pivotally coupled to the arm and a base plate.

A preferred embodiment of the invention will be described with reference to the accompanying drawings in which:

FIG. 1 is a cross-sectional view of a device embodying the invention with a disc of a valve schematically shown in a closed position;

FIG. 2 is a view along the line II—II of FIG. 1 with a disc shown in the open position;

FIGS. 3*a* and 3*b* are graphs showing the relation between the force and position of the disc and the torque imparted to the disc and the position of the disc respectively;

FIG. 4 is a front view of a second embodiment; and

FIG. 5 is a side view of the embodiment of FIG. 4.

Referring to FIG. 1 the device 10 for assisting closure of a valve disc 12 comprises an arm 14 which has a square hole 16. Fixed in the hole 16 is a shaft 18 which extends through the valve body 72 and is connected to the valve disc 12 which regulates flow through the valve (not shown). Axis Z in FIG. 2 denotes the rotational axis of valve disc 12 as it rotates between fully opened position and a closed position. The arm 14 has a bifurcated portion 20 which is provided with a hole 22 to enable the arm to be pivotally connected to a biasing means 24 by a pin 26 which has a center axis X.

The biasing means 24 comprises a connector 28 which has a hole 30 for receiving the pin 26. The connector 28 has a circular recess 32 which receives and retains a sleeve 34 which is provided with a screw thread 36 (see FIG. 2). An annular top plate 38 having an opening 40 provided with a screw thread is screwed onto the sleeve 34. A coil spring 42 and a rod 44 are located between the top plate 38 and an annular bottom plate 46 with the rod 44 extending up into sleeve 34. The lower end of the rod 44 is secured in a circular recess 48 on plate 46. The plate 38 and 46 are provided with projections 50 for retaining the spring 42 between the plates. The top plate 38 is screwed onto the sleeve 34 a sufficient distance to ensure that the coil spring 42 is compressed when the biasing means 24 and arm 14 are in a straight line as shown in FIGS. 1 and 2.

The bottom plate 46 is provided with a stem 52 which has a hole 54. The stem 52 is received in a bifurcated bracket 56 which has a hole 58 to enable the plate 46 to be pivotally connected to the bracket by a pin 60. The bracket 56 is securely connected to a base plate 64 by, for example, a bolt 62 and the base plate is coupled to the valve body. The plate 64 and bracket 56 may be provided with intermeshing teeth 67 (FIG. 2) to securely retain the bracket 56 on the plate and to allow adjustment.

The operation of the device 10 will be described with reference to FIG. 2. FIG. 2 shows a valve disc 12 in the open position with the flow through the valve being the direction of arrow A. As shown in FIG. 2, when the valve is fully open the biasing means 24, center axis X of pivot pin 26 and arm 14 are in a straight line so that no torque (as shown by the graph in FIG. 3*b*) is imparted to the disc 12. When disc 12 is fully open, upstanding member 73 of disc 12 contacts a portion of valve body 72 so as to prevent further rotation of disc 12 in the direction of arrow C. If the velocity of the liquid flow through the valve drops below that required to main-

tain the disc in the open position the disc 12 will rotate in the direction of arrow B about shaft 18. This will cause the arm 14 to move with shaft 18 into the position shown in dotted lines in FIG. 2. the biasing means 24 will be drawn by the arm 14 into the position represented by line C in view of the pivotal connection between the arm 14 connector 28 and the plate 46.

Once the arm starts to move into the position shown in dotted lines the arm, center axis X and biasing means are no longer in a straight line and the force of the spring 42 commences to act to push the arm 14, shaft 18 and disc 12 in the direction of movement of the disc 12. Accordingly torque is imparted by the biasing means 24 to the arm 14, shaft 18 and then to the disc 12 to force the disc 12 to close. As the spring 42 extends, plate 38 and stem 34 move upwardly with respect to the rod 44 until the spring is fully extended. Preferably the spring should reach its fully extended position when the valve disc 12 has reached its closed position.

As shown in FIGS. 3*a* and 3*b* a large force acts on the arm when the valve disc 12 is in the open position but in view of the geometry of the arm, biasing means and disc 12 when in the open position there is no torque acting on the disc 12. As soon as the disc 12 starts to move it is imparted to the disc via the arm 14 and shaft 18 to assist in closure of the disc 12. The force imparted by the spring 42 is of course greatest when the spring is compressed and reduces as the spring expands. However the torque imparted to the disc 12 increases as the disc closes and reaches a peak when the disc is about half closed. However at all times during closure of the disc spring 42 causes torque to be imparted to the disc 12 to cause the disc 12 to close quickly and prevent backflow through the valve.

When the valve is again opened it of course must be opened against the bias of the spring 42. However once the valve is fully opened, as noted above, no torque is imparted to the disc 12.

With reference to FIGS. 4 and 5 which show a second embodiment which utilizes two closing devices, one on each side of the disc 12. The closing devices are supported on a bracket 100 and comprise a bolt and nut assembly 102 firmly fixed to the bracket which has a hole for receiving one end of a tension spring 104. The other end of the tension spring 104 is connected to a lever 106. The lever 106 is connected to a closure arm 108 by means of a pivot pin 110 having a center axis Y. As seen in FIG. 4 the closure arm 108 is arranged inwardly with respect to the disc valve 12 of the lever 106. The closure arm 108 is connected to a shaft 112 which is coupled to the disc valve 12.

When the disc valve 12 is in the open position the spring 104, lever 106, center axis Y and closure arm 108 form a straight line so that no torque is imparted to the disc 12 by means of the tension spring 104. As the disc 12 commences to move into the closed position (which is shown in FIGS. 4 and 5) the closure arm 108 moves relative to the lever 106 and spring 104. Once the arms move out of the straight line configuration with the center axis Y the tension spring 104 biases the lever 106 to draw the lever downwardly in FIG. 5 so that the lever arm causes the disc 12 to rotate in a direction of arrow B into the closed position. It will of course be noted that the lever arm 108 is coupled to the valve disc 12 by the shaft 112 in a similar manner to that described with reference to FIGS. 1 and 2 so that the shaft 112 cannot rotate relative to the closure arm 108.

Accordingly the present invention provides a device for assisting closure of a valve which enables the valve to close quickly thereby preventing backflow through the valve and damage to the valve and any pump upstream of the valve and also reduces the pressure drop of the fluid through the valve as the disc is in the open position because no torque is imparted to the disc when the disc is in the open position.

I claim:

1. A device for assisting closure of a valve element, said device comprising a closure member coupled to said valve element so as to rotate the valve element about an axis between a normally open position and a closed position, and biasing means coupled for relative movement to the closure member by a connecting pin, such that when the valve element is in an open position the closure member and biasing means are in a single generally straight line with the center axis of the connecting pin and the valve rotation axis, the closure member and the biasing means applying no torque to the valve element to move the valve when the valve element is in its usual open operational position and when the valve element commences to close, the closure member is moved relative to the biasing means so that the biasing means and closure member are no longer in a single straight line with the center axis of the connecting pin and the valve rotation axis and so that torque is continuously exerted by the biasing means through the closure member to assist closure of the valve.

2. The device of claim 1 wherein the biasing means comprises a biasing element disposed between a pair of support means, one of said support means being coupled to a sleeve, said sleeve receiving a rod which is coupled to the other of the support means such that said one of said support means and the sleeve are movable relative to the rod under the influence of the biasing element.

3. The device of claim 2 wherein said pair of support means comprise a pair of plates.

4. A device according to claim 1, 2 or 3 wherein said closure member is coupled to the valve element by a shaft, the shaft having a portion which is received in the closure member for fixing the shaft relative to the closure member.

5. The device according to claim 1 wherein said closure member is a bifurcated member which receives the biasing means and the closure member and the biasing means as pivotally coupled together.

6. A device for assisting closure of a valve element, said device comprising a valve closure member coupled to the valve element so as to rotate the valve element about an axis between a normally open position and a closed position, biasing means coupled for relative movement to the closure member by a connecting pin, said biasing means comprising a biasing element supported between a pair of support members, one of the support members being coupled to a sleeve which receives a rod which is coupled to the other of the support members, the closure member and biasing means being in a single generally straight line with the center axis of the connecting pin and the valve rotation axis when the valve element is in an open position so that the closure member and biasing means apply no torque to the valve element to close the valve element, and when the valve element commences to close, the closure member is moved relative to the biasing means so the biasing means and closure member are no longer in a single straight line with the center axis of the connecting pin

and the valve rotation axis and so that torque is continuously exerted by the biasing means through the closure member to assist closure of the valve.

7. A device according to claim 1 or 6 wherein the closure member comprises a bifurcated arm which is pivotally coupled to the biasing means.

8. A device according to claim 7 wherein the support members comprise plates and the plate to which the rod is connected is pivotally connected to a base member.

9. A device according to claim 8 wherein said biasing element comprises a coil spring which surrounds said rod and said sleeve.

10. A device according to claim 1 wherein the closure member comprises a closure arm coupled to the valve member and a lever pivotally coupled to the closure arm, said biasing means comprising a tension spring arranged between the lever arm and a base member.

11. A device according to claim 10 wherein said closure member is arranged inwardly of the lever arm and is pivotally coupled to the lever arm by a pivot pin.

12. A device according to claim 1, 10 or 11 coupled on opposed sides of the valve member.

13. A device according to claim 11 where the base member is a L-shaped bracket.

14. A device according to claim 6 wherein the support members comprise plates and the plate to which the rod is connected is pivotally connected to a base member.

15. The device according to claim 6 wherein said biasing element comprises a coil spring which surrounds said rod and said sleeve.

16. A device according to claim 7 wherein said biasing element comprises a coil spring which surrounds said rod and said sleeve.

17. A device as defined in claim 1 further comprising means for preventing the valve element from opening beyond a predetermined position.

18. A device as defined in claim 6 further comprising means for preventing the valve element from opening beyond a predetermined position.

* * * * *

United States Patent [19]

Rogers et al.

[11] **Patent Number: 4,639,016**

[45] **Date of Patent: Jan. 27, 1987**

[54] **PIPELINE REPAIR KIT**

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[73] Assignee: **Aeroquip Corporation**, Jackson, Mich.

[21] Appl. No.: **588,354**

[22] Filed: **Mar. 12, 1984**

[51] Int. Cl.[4] **F16L 27/00**

[52] U.S. Cl. **285/15**; 285/31; 285/163; 285/168; 285/181; 285/184; 285/276

[58] Field of Search 285/31, 181, 363, 368, 285/382, 15, 16, 17, 163, 168, 169, 184, 276; 405/170; 138/97; 29/402.8, 402.12, 402.14

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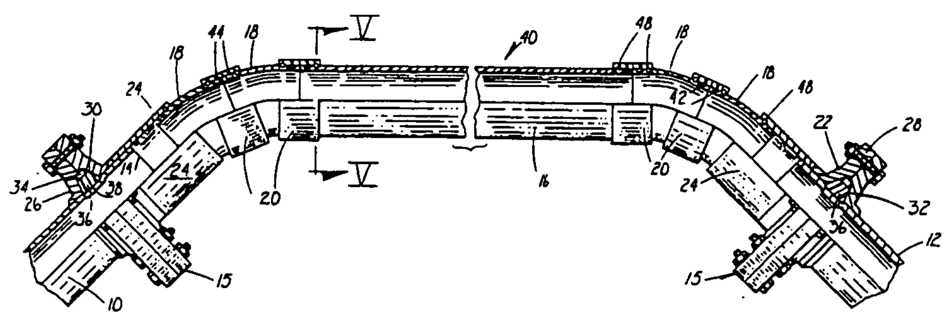
Primary Examiner—Cornelius J. Husar
Assistant Examiner—Eric K. Nicholson
Attorney, Agent, or Firm—Beaman & Beaman

[57] **ABSTRACT**

A system for repairing pipeline, such as underground fuel, gas or water pipeline systems which have been damaged by explosives, wherein the ruptured sections have been misaligned. Quick-connect fittings are attached to the misaligned pipe ends after trimming and a bridging conduit system is interposed between the fittings having adjustable portions for accommodating the misalignment. Rotative angular sections provide universal adjustment while retaining the fluid-tight integrity of the apparatus.

5 Claims, 5 Drawing Figures



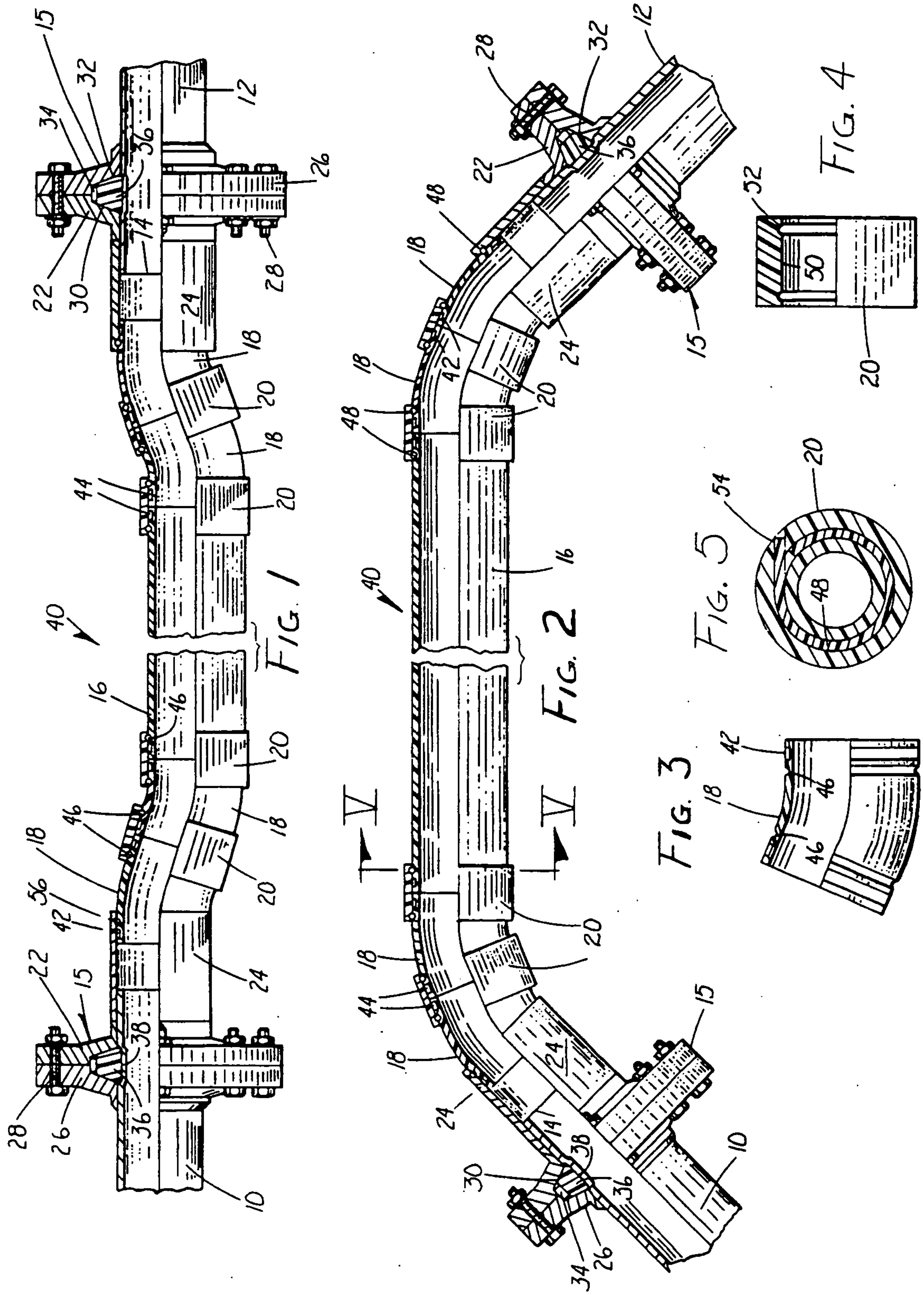


FIG. 1

FIG. 2

FIG. 3

FIG. 4

FIG. 5

PIPELINE REPAIR KIT

BACKGROUND OF THE INVENTION

In airfields, for instance, it is common to bury fuel lines for supplying the aircraft, and such fuel lines will often be of high capacity, for instance, 8" diameter. In the event of an air attack such fuel lines may be damaged and portions of the pipeline severely bent and ruptured. Rapid repair of such fuel lines is of utmost importance.

It is an object of the invention to provide a pipeline repair system capable of quickly repairing large diameter conduits with rigid tubular inserts wherein such repair causes no restrictions to fluid flow, and may be used permanently.

Another object of the invention is to provide a pipeline repair system utilizing rigid conduit inserts wherein the configuration of the conduit system may be infinitely varied between wide limits to permit accommodation to the misaligned ends of the damaged pipeline.

A further object of the invention is to provide a pipeline repair system utilizing fittings attached to the damaged pipe wherein a strong mechanical connection to the damaged pipe is achieved having excellent sealing integrity, and which may be installed by average skilled workers.

An additional object of the invention is to provide a pipeline repair system rapidly adjustable to accommodate misaligned damaged pipe ends, and wherein the system includes a plurality of relatively rotatable interconnected inserts highly resistant to axial separation.

In the practice of the invention the damaged section of a ruptured pipeline is cut out and the pipe is trimmed to provide squared ends. A fitting is applied to each pipe end utilizing an axially displaceable flange which compresses an annular seal upon the damaged pipe mechanically affixing the fitting to the pipe in a fluid-tight relationship. The fitting includes an axially disposed extension extending beyond the end of the pipe.

The bridging conduit system inserts include a primary bridging conduit of a linear rigid configuration having angularly disposed elbow sections rotatively associated with the ends thereof. By rotation of the angle elbow sections a wide variety of angular relationships may be produced to align the ends of the bridging system with the fitting extensions for attachment thereto.

A sealing means in the form of couplings, seal rings and drive wires interconnect the components of the bridging system, and the bridging system with the fittings, wherein relative rotation between the components is possible for adjustment purposes, yet a fluid-tight system is produced. Adjustment between the components, and assembly of the components to the pipeline, is accomplished with non-skilled personnel, and by utilizing different lengths of primary bridging conduits a wide variety of pipeline breaks can be quickly repaired.

DESCRIPTION OF THE DRAWINGS

The aforementioned objects and advantages of the invention will be appreciated from the following description and accompanying drawings wherein:

FIG. 1 is an elevational view, partially sectioned, of a pipeline repair system in accord with the invention showing accommodation of the system to pipes having minor misalignment,

FIG. 2 is an elevational, partially sectioned view of the pipeline repair system as installed upon severely misaligned pipe ends,

FIG. 3 is an elevational view, partially sectioned, of an angle elbow,

FIG. 4 is an elevational, partially sectioned view of a coupling as used with the invention, and

FIG. 5 is an elevational, sectional view as taken along Section V—V of FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In the drawings, the pipeline that has been damaged is represented by pipe sections 10 and 12. The pipe sections 10 and 12 of FIG. 1 are each provided with a squared end 14 which is a result of the pipe being trimmed prior to repair. The damaged pipe portion, not shown, has been cut away and discarded. In FIG. 1 the pipeline sections, 10 and 12 are only misaligned to a minor degree, while in FIG. 2 major misalignment has occurred, for instance, as a result of an explosion occurring below the pipe which would lift the same during rupture. The different degrees of misalignment illustrated in FIGS. 1 and 2 typifies situations of damaged pipe orientation which may be accommodated by the invention.

The pipeline repair system of the invention is furnished in the form of a kit which includes two pipe fittings 15 and a bridging conduit system which includes a plurality of conduit inserts such as a primary linear rigid bridging conduit 16, and four angle elbow fittings 18 plus four couplings 20. Several lengths of bridging conduits 16 may be included in the kit.

The identical fittings 15 each include a body having a radially extending collar 22 and a tubular extension 24 having a cylindrical inner surface. A flange 26 attaches to the collar 22 by a plurality of circumferentially spaced bolts 28, and the collar is provided with a conical surface 30 while the flange is formed with an axially opposed complementary conical surface 32 which, together, define the chamber 34 having sides which diverge in an inward direction.

An elastomeric ring 36 is received within the chamber 34, and preferably, the ring is formed of polyurethane.

The normal inner diameter of the ring 36 is substantially equal to the outer diameter of the pipe 10 or 12, and the fitting 15 may be inserted over the end of the pipe portion when the bolts 28 are unloosened. Upon the fitting 15 being oriented on the associated pipe section as shown in FIG. 1, wherein the extension 24 extends beyond the pipe end 14, the bolts 28 are tightened which compresses the tapered sides of the ring forcing the seal ring inwardly which will deform the pipe section inwardly to define a groove 38, and in this manner a firm mechanical connection of the fitting to the associated pipe section is achieved, as well as an excellent fluid-tight seal.

Upon measuring the distance separating the pipe ends 14, the installer assembles the appropriate conduit bridge system components. The bridge system 40 includes the primary rigid linear conduit 16, and a plurality of angle elbows 18 having an offset of approximately 20°. The conduit 16, and elbows 18, adjacent each end thereof are provided with an annular recess 42 for re-

ceiving an O-ring 44, and a semi-circular groove 46 for receiving the drive pin 48, FIG. 5.

A cylindrical coupling 20 is associated with adjacent elbows and the primary bridge conduit, and the coupling includes an inner cylindrical surface 50 for engagement by the O-rings 44, and also includes the outer portion of the drive pin groove 52. The couplings are provided with a tangential hole 54 whereby the drive pin 48 may be inserted when the grooves 46 and 52 of the coupling and conduits are aligned.

Likewise, the fitting extensions 24 are provided with a drive pin groove 56 and tangential hole, not shown.

The bridging system conduit and elbows are assembled by locating the O-rings 44 within the recesses 42 and the couplings are placed upon the components such that an end-to-end abutting relationship between the conduit and elbows permits the couplings to be positioned to align with the drive pin grooves of the conduit and elbow permitting insertion of the nylon drive pins 48 to permanently interconnect adjacent conduits and elbows. This interconnection permits relative rotative movement between adjacent components, but prevents axial displacement therebetween.

To permit assembly of the system to the pipeline several sequences of assembly may be used. For instance, the entire repair assembly may be assembled prior to the fittings 15 being tightened onto pipe portions. The extensions 24 are of great enough length so that one fitting 15 may be inserted on a pipe section 10 or 12 a sufficient distance to permit the other fitting 15 to be aligned with its adjacent pipe section and then the assembly moved in the opposite direction to place the second fitting upon its pipe section. Thereupon, the bolts 28 are tightened to compress the seal rings 36 upon the encircled pipe section. Another mode of assembly is to initially place the fittings 15 upon their associated pipe section, but not insert the drive pin 48 into one of the couplings 20 associated with the primary linear bridging conduit 16. The "loose" coupling is merely placed upon the conduit 16, and the uncoupled conduit end is aligned with the adjaceht elbow end. Upon alignment taking place due to transverse movement of the conduit or elbow, the coupling 20 is slipped over the elbow end, the drive pin grooves aligned and the drive pin inserted to complete the assembly.

As a pair of angle elbows 18 are usually employed at each end of conduit 16 the relative rotative adjustment of the elbows permits a wide variety of angular relationships to be achieved, and the utilization of four angle elbows permits practically all pipeline breaks to be repaired. Merely by rotating the elbows an infinite number of angular relationships can be achieved and accurate alignment with misaligned pipe sections 10 and 12 is readily accomplished without requiring special skills.

The conduit 16, the angle elbows 18 and couplings 20 may be formed of synthetic plastic or metal, the repair of the pipeline is of a permanent nature, and the repair components can be buried, if desired. Repair of a pipeline with the apparatus of the invention produces no restrictions to fluid flow, and only average skills are required for installation.

It is appreciated that various modifications to the inventive concepts may be apparent to those skilled in the art without departing from the spirit and scope of the invention.

We claim:

1. A pipeline repair system for interconnecting the spaced and misaligned ends of a ruptured pipeline having a cylindrical exterior surface comprising, in combination, a pair of tubular pipeline fittings each having compression sealing means for producing a sealing connection to the exterior cylindrical surface of a pipeline end and a tubular cylindrical extension for extending beyond the associated pipeline end, a primary rigid linear bridging conduit having cylindrical ends located between said fittings, a pair of angle conduits having cylindrical ends located adjacent each end of said bridging conduit and adjacent a pipeline fitting, each of said angle conduits having an outer cylindrical end and an inner cylindrical end, the axes of said cylindrical ends of an angle conduit intersecting and being angularly offset relative to each other, first rotatable sealing means sealing said inner cylindrical ends of an associated pair of angle conduits in rotatable aligned relationship whereby relative rotation of the associated angle conduits changes the angular relationship of said outer cylindrical ends of the associated angle conduits, second rotatable sealing means defined upon said ends of said bridging conduit rotatably sealing an outer end of each pair of associated angle conduits in communication therewith, and third rotatable sealing means rotatably sealing the other outer end of each pair of associated angle conduits to a pipeline fitting extension in communication therewith to establish sealed communication between the pipeline ends, said sealing means each including annular rotatable locking means interposed between the associated angle conduits, the associated bridging and angle conduits and the associated angle conduits and pipeline fitting extensions permitting relative rotation therebetween and preventing relative axial displacement thereof.

2. In a pipeline repair system as in claim 1, said first and second rotatable sealing means including tubular couplings having internal cylindrical surfaces, and seal rings interposed between said couplings and the associated angle conduit inner ends and the associated bridging and angle conduit outer ends.

3. In a pipeline repair system as in claim 2, said annular rotatable locking means interposed between the associated couplings, bridging and angular conduits and fitting extensions preventing relative axial displacement thereof comprising aligned annular grooves defined in said couplings, bridging and annular conduits and fitting extensions, and a drive pin tangentially inserted into said aligned grooves conforming to the annular configuration thereof.

4. In a pipeline repair system as in claim 1, said axes of said inner and outer cylindrical ends of a common angle conduit being offset approximately 20°.

5. In a pipeline repair system as in claim 3, said drive pins being formed of a synthetic plastic material.

* * * * *

United States Patent [19]

Willson

[11] Patent Number: 4,802,507

[45] Date of Patent: Feb. 7, 1989

[54] GAS FLOW CONTROL DEVICE

[75] Inventor: James R. Willson, Ashland, Mass.

[73] Assignee: Kidde, Inc., Saddle Brook, N.J.

[21] Appl. No.: 46

[22] Filed: Jan. 2, 1987

[51] Int. Cl.⁴ F16K 31/126

[52] U.S. Cl. 137/613; 137/505.12

[58] Field of Search 137/505.12, 509, 510, 137/613

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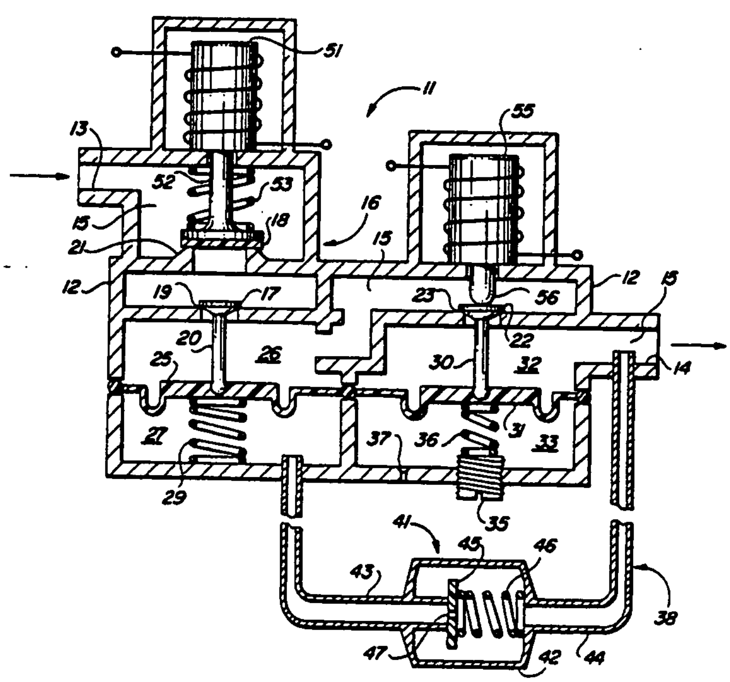
Primary Examiner—A. Michael Chambers
Assistant Examiner—John C. Fox
Attorney, Agent, or Firm—John E. Toupal; Harold G. Jarcho

[57] ABSTRACT

A gas flow control device including a body means defining an inlet, an outlet and a gas flow passage therebetween a main valve disposed in the passage and comprising a primary valve movable between a closed position that prevents flow through the passage and an open position that permits flow therethrough; a primary diaphragm operably connected to the primary valve and supported by the body means, the primary diaphragm defining within the body and separating a primary reference chamber from a primary regulator chamber located in the passage and the pressure in the primary reference chamber exerting a force tending to open the primary valve; and a primary bias means biasing the primary valve toward its open position. Also included in the device is a secondary valve disposed in the passage between the primary valve and the outlet, the secondary valve movable between a closed position that prevents flow through the passage and an open position that permits flow therethrough; a secondary diaphragm operably connected to the secondary valve and supported by the body, the secondary diaphragm defining with the body and separating a secondary reference chamber from a secondary regulator chamber located in the passage and the pressure in the secondary regulator chamber exerting a force tending to close the secondary valve; a secondary bias means biasing the secondary valve toward the open position and a control passage providing communication between the primary reference chamber and the outlet.

25 Claims, 1 Drawing Sheet



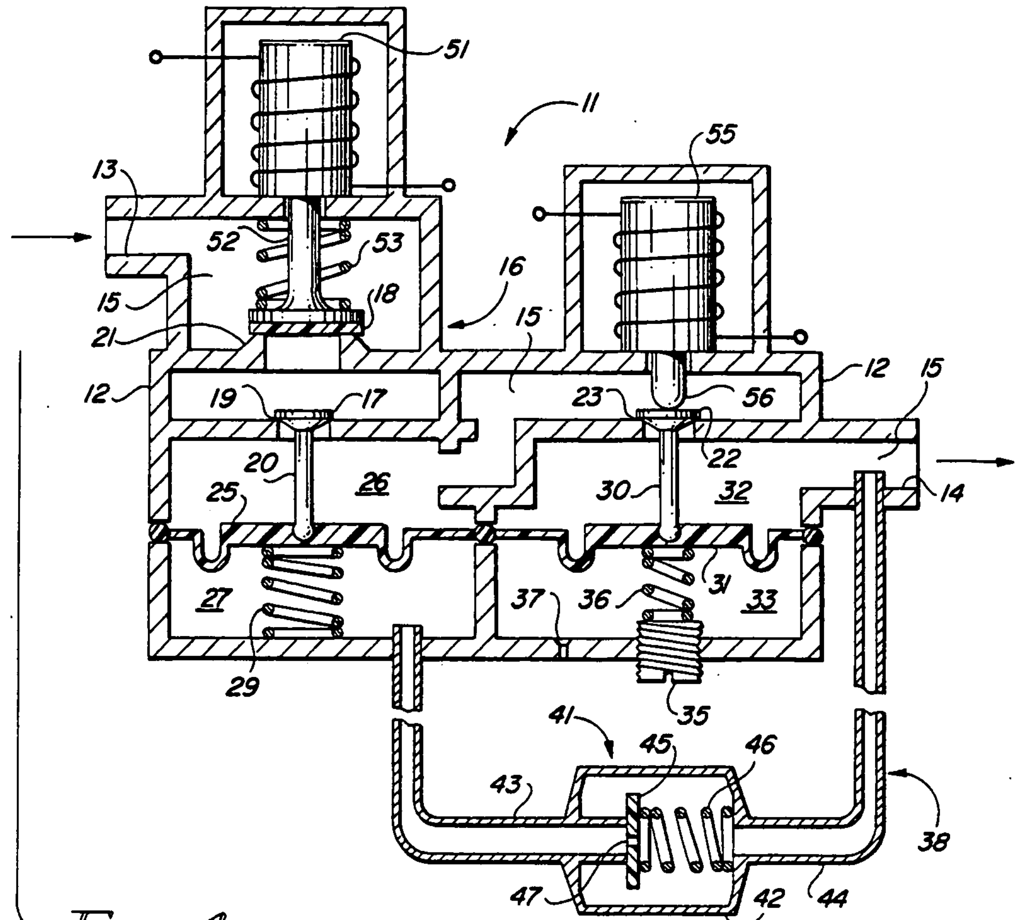

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FIG. 1

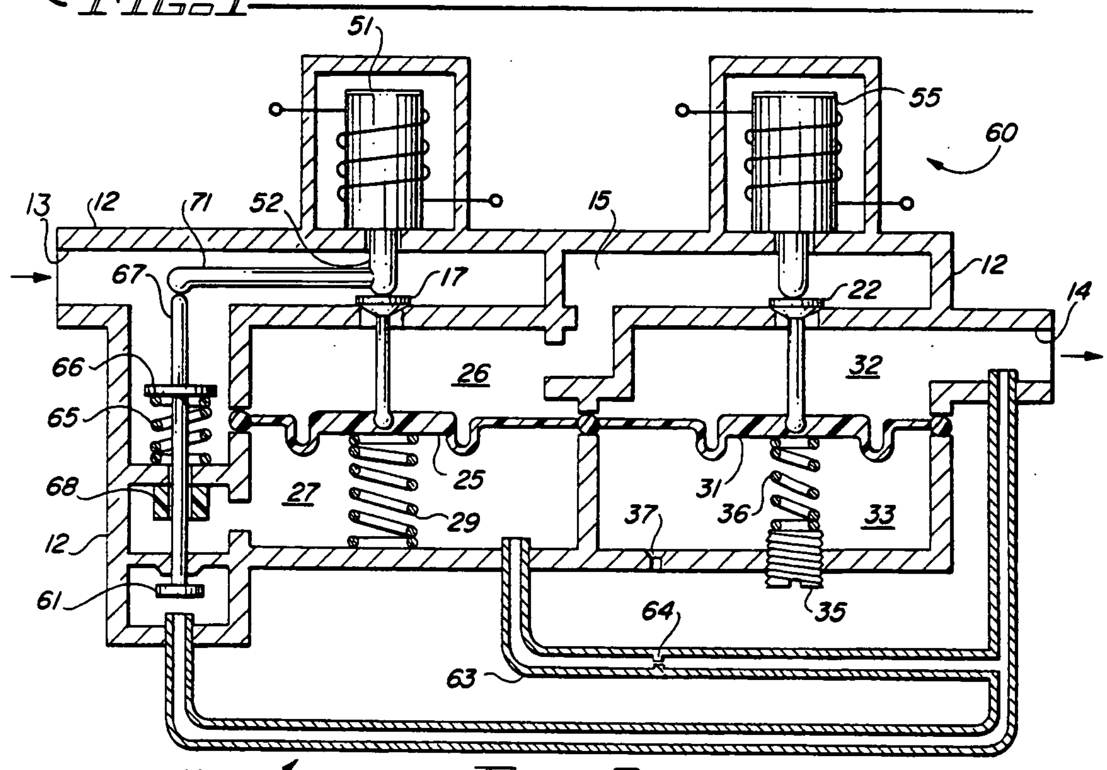
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FIG. 2

GAS FLOW CONTROL DEVICE

BACKGROUND OF THE INVENTION

This application relates generally to a gas flow control device and, more particularly, to such a device in which full rated flow is preceded by a period of reduced flow that effects limited combustion in a burner.

The safe operation of many gas burners, particularly those enclosed in relatively compact combustion chambers, requires a start-up period of reduced gas flow preceding full rated flow. During the period of reduced flow, there is developed sufficient draft through the combustion chamber to support combustion of the subsequent full rated flow.

There have been developed and proposed various gas flow control devices, commonly known as stepped opening or slow opening valves that can delay full rated gas flow to a burner. Although many of these devices effectively accomplish the desired delay in full rated flow, they suffer from a number of individual and collective disadvantages including, for example, critical operation characteristics and high construction costs. Examples of stepped opening valves are disclosed in U.S. Pat. Nos. 3,300,174; 3,386,467; 3,351,085; 3,354,901; 3,502,101; 3,552,430; 3,578,243; 3,721,263; 3,776,268; 3,800,823; 3,880,186; 3,896,857; 4,009,861; 4,060,370; 4,217,928 and 4,254,796.

The object of this invention, therefore, is to provide an improved, relatively low cost gas flow control device that efficiently provides an initial period of reduced gas flow preceding full rated gas flow.

SUMMARY OF THE INVENTION

The invention is a gas flow control device including a body means defining an inlet, an outlet and a gas flow passage therebetween a main valve disposed in the passage and comprising a primary valve movable between a closed position that prevents flow through the passage and an open position that permits flow therethrough; a primary diaphragm operably connected to the primary valve and supported by the body means, the primary diaphragm defining with the body and separating a primary reference chamber from a primary regulator chamber located in the passage and the pressure in the primary reference chamber exerting a force tending to open the primary valve; and a primary bias means biasing the primary valve toward its open position. Also included in the device is a secondary valve disposed in the passage between the primary valve and the outlet, the secondary valve movable between a closed position that prevents flow through the passage and an open position that permits flow therethrough; a secondary diaphragm operably connected to the secondary valve and supported by the body, the secondary diaphragm defining with the body and separating a secondary reference chamber from a secondary regulator chamber located in the passage and the pressure in the secondary regulator chamber exerting a force tending to close the secondary valve; a secondary bias means biasing the secondary valve toward the open position and a control passage providing communication between the primary reference chamber and the outlet. During a start-up period the primary valve regulates outlet pressure at a reduced pressure while gas flow between the outlet and the primary reference chamber provides a subsequent increase in the outlet pressure.

According to one feature of the invention the control passage comprises a check valve providing restricted flow from the outlet to the primry reference chamber and full flow from the primary reference chamber to the outlet. The restricted flow through the check valve controls the increase in outlet pressure while the full flow permits rapid dumping of the primary reference chamber after shut-off.

According to other features of the invention, the device further includes a primary actuator coupled to the main valve and operable in a first state to prevent flow therethrough and operable in a second state to permit flow therethrough, and a secondary actuator coupled to the secondary valve and operable in one state to prevent flow therethrough and operable in another state to permit flow therethrough. The primary and secondary actuators permit control of the device by a thermostat.

According to one embodiment of the invention, the main valve comprises an auxiliary valve disposed in the passage between the inlet and the primary valve and the device further includes an actuator coupled to the auxiliary valve and operable in a first state to prevent flow therethrough and operable in a second state to permit flow therethrough. The auxiliary valve facilitates rapid opening of the device by permitting the primary valve to remain open during shut-off.

According to another embodiment of the invention, the device includes a vent valve connected between atmosphere and the primary reference chamber and adapted to normally vent the primary reference chamber and to close and allow a pressure increase therein in response to movement of the main valve to the open position. The vent valve facilitates rapid cycling of the device by both bleeding off pressure from the primary reference chamber and preventing the existence of a vacuum therein during quick re-starts of gas flow.

DESCRIPTION OF THE DRAWINGS

These and other objects and features of the invention will become more apparent upon a perusal of the following description taken in conjunction with the accompanying drawings wherein:

FIG. 1 is a schematic cross sectional view of a gas flow control device in accordance with the present invention; and

FIG. 2 is a schematic fragmentary cross sectional view of another embodiment of the device shown in FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Constructed in accordance with one embodiment of the invention is a gas flow control device 11 shown in FIG. 1. A casing body 12 defines an inlet 13 for connection to a source of gas, an outlet 14 for connection to a combustion burner and a gas flow passage 15 therebetween. Disposed within the passage 15 for controlling gas flow therethrough is a main valve 16 assembly including a primary valve 17 and an auxiliary valve 18. The series connected primary valve 17 and auxiliary valve 18 are accommodated, respectively, by valve seats 19 and 21 defined by the body 12. Also disposed in the gas flow passage 15 between the primary valve 17 and the outlet 14 is a secondary valve 22 accommodated by a valve seat 23.

Operably connected to a stem 20 of the primary valve 17 is a primary diaphragm 25 retained by the body 12.

Together the primary diaphragm 25 and the body 12 define a primary regulator chamber 26 within the gas flow passage 15 and a primary reference chamber 27 separated therefrom by the primary diaphragm 25. In response to pressure induced movement of the diaphragm 25, the primary valve 17 is moved between a closed position engaging the seat 19 and preventing gas flow through the passage 15 and an open position permitting gas flow therethrough. A primary bias spring 29 extends between the body 12 and the primary diaphragm 25 and exerts thereon a force tending to open the primary valve 17.

Operatively connected to a stem 30 of the secondary valve 22 and supported by the body 12 is a secondary diaphragm 31. Together the body 12 and the secondary diaphragm 31 define a secondary regulator chamber 32 disposed in the flow passage 15 and a secondary reference chamber 33 separated therefrom by the secondary diaphragm 31. In response to pressure induced movement of the secondary diaphragm 31, the secondary valve 22 is moved between a closed position engaging the seat 23 and preventing gas flow through the flow passage 15 and an open position permitting flow therethrough. Extending between the secondary diaphragm 31 and an adjustable threaded plug 35 in the body 12 is a secondary bias spring 36. Produced on the secondary diaphragm 31 by the secondary bias spring 36 is a force tending to open the secondary valve 22. Atmospheric pressure is maintained in the secondary reference chamber 33 by a vent orifice 37.

A control passage 38 has one end communicating with the outlet 14 and an opposite end communicating with the primary reference chamber 27. Located in the control passage 38 is an assembly 41 for controlling pressure within the primary reference chamber 27. An enclosure 42 joins a section 43 of the control passage 38 connected to the primary reference chamber 27 and a section 44 connected to the outlet 14. Retained by the enclosure 42 is a check valve 45 urged by a bias spring 46 toward a closed position that closes the section 43. Extending centrally through the check valve 45 is a restriction orifice 47.

A primary solenoid actuator 51 has a plunger 52 coupled to the auxiliary valve 18. In a first deenergized state of the primary solenoid 51, the plunger 52 retains the auxiliary valve 18 in a closed position to prevent gas flow through the passage 15. In a second energized state of the solenoid 51, the plunger 52 is withdrawn allowing opening of the auxiliary valve 18 to permit flow to the passage 15. A secondary solenoid actuator 55 has a plunger 56 operatively coupled to the secondary valve 22. In one deenergized state of the solenoid 55, the plunger 56 retains the secondary valve 22 in a closed position to prevent fuel gas flow through the passage 15. In another energized state of the solenoid 55 the plunger is withdrawn to permit opening of the secondary valve 22 by the secondary spring 36 and the secondary diaphragm 31.

OPERATION

In the absence of a call for gas at a burner (not shown) connected to the outlet 14, the deenergized primary solenoid 51 and secondary solenoid 55, respectively, retain the auxiliary valve 18 and the secondary valve 22 in closed positions that prevent gas flow through the flow passage 15. At such time, the same atmospheric pressure exists in the primary flow chamber 26 and the primary reference chamber 27 and the primary spring 29 retains the primary valve 17 in an open position.

Upon a call for gas, the primary solenoid 51 and secondary solenoid 55 are energized to withdraw, respectively, the plungers 52 and 56 and thereby open the auxiliary valve 18 against the spring 53 and permit opening of the secondary valve 22 by the secondary spring 36. Resultant gas flow from the inlet 13 through the open auxiliary and primary valves 18, 17 increases the pressure in the primary regulation chamber 26. In response thereto, the primary diaphragm 25 and the primary spring 29 function as a regulator to maintain a given pressure in the chamber 26. For example, the primary diaphragm 25 and the primary spring 29 can be selected to provide a given initial pressure in the primary flow chamber 26 of approximately 1½ inches water column (W.C.). The secondary valve 22 also is controlled by the secondary diaphragm 31 and the secondary spring 36 to regulate pressure in the secondary regulator chamber 32. Preferably the secondary diaphragm 31 and the secondary spring 36 are selected to limit the pressure in the secondary regulator chamber 32 to a predetermined greater pressure of, for example, 3½ inches W.C. Thus, the initial given pressure in the primary flow chamber 26 less any line pressure drop is transmitted by the secondary valve 22 to the outlet 14.

Gas at the outlet 14 is fed to both a connected burner (not shown) and the primary reference chamber 27 through the control passage 38 and the restriction orifice 47 in the check valve 45. Resultant increasing pressure in the primary reference chamber 27 increases the opening force applied by the primary diaphragm 25 to the primary valve 17 causing the pressure to increase in the primary flow chamber 26 and correspondingly at the outlet 14. The outlet pressure increases until approximately 3½ inches W.C. is reached and retained by the secondary valve 22. At that time, the pressure in the primary regulator chamber 26 and the inlet to the secondary valve 22 is maintained at a pressure determined by the combined forces applied to the primary diaphragm 25 by the primary bias spring 29 and the pressure then existing in the primary reference chamber 27. For the example given above, that operating pressure in the primary regulator chamber 26 will approximate 5 inches W.C.

Any subsequent deenergization of the primary solenoid 51 and the secondary solenoid 55 results in closure of the auxiliary valve 18 and the secondary valve 22 to interrupt gas flow between the inlet 13 and the outlet 14. The check valve 45 responds to the difference in pressure between the primary reference chamber 27 and the outlet 14 by moving against the spring 46 to open the section 43 of the control passage 38. Accordingly, gas pressure in the primary regulator chamber 27 is quickly dumped into the outlet 14 to reestablish atmospheric pressure within the primary reference chamber 27. The return to atmospheric pressure in the primary reference chamber 26 allows the primary spring 29 to maintain the primary valve 17 in an open position prepared for a reopening of the auxiliary valve 18.

Illustrated in FIG. 2 is another embodiment 60 in which parts identical to those of the embodiment 11 shown in FIG. 1 bear the same reference numerals. In the embodiment 60, the check valve 41 and the auxiliary valve 18 of FIG. 1 are replaced by a vent valve 61 connected between the primary reference chamber 27 and the outlet 14 by a vent passage 62. Also, the plunger 52 of the primary solenoid actuator 51 is coupled di-

rectly to the primary valve 17 and the primary reference chamber 27 communicates with the outlet 14 via a control passage 63 having a restriction orifice 64. A spring 65 extends between the body 12 and a skirt 66 on a stem 67 of the valve 61. The spring 65 exerts a closure force on the valve 61 and an annular seal 68 prevents flow between the inlet 13 and the primary reference chamber 27. Operatively connecting the vent valve 61 to the solenoid 51 is an arm 71 mechanically coupled between the plunger 52 and the valve stem 67. The coupling between the primary solenoid 51 and the vent valve 61 is such that in response to a call for gas, the secondary valve 22 and the primary valve 17 are opened after which the vent valve 61 is closed.

Operation of the embodiment 60 is similar to that described for the embodiment 11. However, in the absence of the check valve 41, the vent valve 61 functions to relieve pressure in the primary reference chamber 27 after closing of the primary valve 17 and thereby permit a rapid recycling thereof. In addition, the open vent valve 61 facilitates opening of the primary valve 17 by preventing an initial vacuum in the primary reference chamber 27. Subsequent closing of the vent valve 61 permits a gradual pressure increase in the primary reference chamber 27 via the restricted orifice 64 in the control passage 63. Thus, the restricted orifice 64 and the vent valve 61 provide for the embodiment of FIG. 2 a stepped flow operation similarly provided in the embodiment of FIG. 1 by the check valve 41.

Obviously, many modifications and variations of the present invention are possible in light of the above teachings. It is to be understood, therefore, that the invention can be practiced otherwise than as specifically described.

What is claimed:

1. A gas flow control device comprising:

a body means defining an inlet, an outlet, and a gas flow passsage therebetween;

a main valve means disposed in said flow passage and comprising a primary valve movable between a closed position that prevents flow through said flow passage and an open position that permits flow therethrough;

a primary diaphragm operably connected to said primary valve and supported by said body means, said primary diaphragm defining with said body means and separating a primary reference chamber from a primary regulator chamber located in said flow passage; pressure in said primary reference chamber exerting a force tending to open said primary valve;

a primary bias means biasing said primary valve toward said open position;

a secondary valve disposed in said flow passage between said primary valve and said outlet, said secondary valve movable between a closed position that prevents flow through said flow passage and an open position that permits flow therethrough;

a secondary diaphragm operably connected to said secondary valve and supported by said body means, said secondary diaphragm defining with said body means and separating a secondary reference chamber from a secondary regulator chamber located in said flow passage, pressure in said secondary regulator chamber exerting a force tending to close said secondary valve;

a secondary bias means biasing said secondary valve toward said open position; and

control passage means including a gas flow restriction providing restricted gas flow between said primary reference chamber and said outlet, said control passage means adapted to transmit to said primary reference chamber changes in the gas pressure at said outlet after a substantial delay provided by said gas flow restriction.

2. A device according to claim 1 wherein said control passage means comprises a valve means providing said restricted flow from said outlet to said primary reference chamber and full flow from said primary reference chamber to said outlet.

3. A device according to claim 2 including primary actuator means coupled to said main valve and operable in a first state to prevent flow therethrough and operable in a second state to permit flow therethrough.

4. A device according to claim 3 including a secondary actuator means coupled to said secondary valve and operable in one state to prevent flow therethrough and operable in another state to permit flow therethrough.

5. A device according to claim 1 wherein said primary bias means and said primary diaphragm are adapted in response to initial flow between said inlet and said primary regulator chamber to limit the pressure therein to a given level and to provide a stepped increase in the pressure therein in response to a delayed increase in pressure in said primary reference chamber produced by gas flow thereto through said control passage from said outlet.

6. A device according to claim 5 wherein said secondary bias and said secondary diaphragm are adapted to limit the pressure in said secondary regulator chamber to a predetermined level greater than said given level.

7. A device according to claim 6 wherein said secondary reference chamber is vented to the atmosphere.

8. A device according to claim 6 wherein said control passage means comprises a check valve means providing said restricted flow from said outlet to said primary reference chamber and full flow from said primary reference chamber to said outlet.

9. A device according to claim 1 wherein said main valve further comprises an auxiliary valve disposed in said flow passage between said inlet and said primary valve.

10. A device according to claim 9 including an actuator means coupled to said auxiliary valve and operable in a first state to prevent flow therethrough and operable in a second state to permit flow therethrough.

11. A device according to claim 1 wherein said control passage means comprises a restricted passage and including vent means for venting said primary reference chamber after movement of said main valve means into said closed position.

12. A device according to claim 11 wherein said vent means comprises a normally open vent valve between atmosphere and said primary reference chamber, said vent valve closing in response to movement of said main valve to said open position.

13. A device according to claim 12 including primary actuator means coupled to said main valve and operable in a first state to prevent flow therethrough and operable in a second state to permit flow therethrough.

14. A device according to claim 13 wherein said vent valve comprises operator means responsive to a change in said primary actuator from said first state to said second state.

15. A device according to claim 14 wherein said primary bias means and said primary diaphragm are

adapted in response to initial flow between said inlet and said primary regulator chamber to limit the pressure therein to a given level and to permit an increase in the pressure therein in response to increased pressure in said primary reference chamber produced by flow thereto from said outlet.

16. A device according to claim 15 wherein said secondary bias and said secondary diaphragm are adapted to limit the pressure in said secondary flow chamber to a predetermined level greater than said given level.

17. A device according to claim 11 wherein said primary bias means and said primary diaphragm are adapted in response to initial flow between said inlet and said primary regulator chamber to limit the pressure therein to a given level and to permit an increase in the pressure therein in response to increased pressure in said primary reference chamber produced by flow thereto from said outlet.

18. A device according to claim 17 wherein said secondary bias and said secondary diaphragm are adapted to limit the pressure in said secondary regulator chamber to a predetermined level greater than said given level.

19. A gas flow control device comprising:

a body means defining an inlet, an outlet, and a gas flow passage therebetween;

a main valve means disposed in said passage and comprising a primary valve movable between a closed position that prevents flow through said passage and an open position that permits flow therethrough;

a primary diaphragm operably connected to said primary valve and supported by said body means, said primary diaphragm defining with said body means and separating a primary reference chamber from a primary regulator chamber located in said passage, pressure in said primary reference chamber exerting a force tending to open said primary valve;

a primary bias means biasing said primary valve toward said open position;

a secondary valve disposed in said passage between said primary valve and said outlet, said secondary valve movable between a closed position that prevents flow through said passage and an open position that permits flow therethrough;

a secondary diaphragm operably connected to said secondary valve and supported by said body means, said secondary diaphragm defining with said body means and separating a secondary reference chamber from a secondary regulator chamber located in said passage, pressure in said secondary regulator chamber exerting a force tending to close said secondary valve;

a mechanical secondary bias means coupled to said secondary valve and applying thereto a mechanical force biasing said secondary valve toward said open position said secondary bias means being manually adjustable so as to permit selective variation in the mechanical force applied to said secondary valve; and

control passage means providing communication between said primary reference chamber and said outlet, said control passage means including a gas flow restriction providing restricted gas flow between said primary reference chamber and said outlet and adapted to transmit to said primary reference chamber changes in the gas pressure at said outlet after a substantial delay provided by said gas flow restriction.

20. A device according to claim 19 wherein said secondary bias and said secondary diaphragm are adapted to limit the pressure in said secondary regulator chamber to a predetermined level greater than said given level.

21. A device according to claim 20 wherein said secondary reference chamber is vented to the atmosphere.

22. A device according to claim 19 wherein said secondary reference chamber is hermetically sealed from said gas flow passage so as to prevent the flow of gas therebetween.

23. A device according to claim 19 wherein said primary bias means and said primary diaphragm are adapted in response to initial flow between said inlet and said primary regulator chamber to limit the pressure therein to a given level and to provide a stepped increase in the pressure therein in response to a delayed increase in pressure in said primary reference chamber produced by gas flow thereto through said control passage and from said outlet.

24. A device according to claim 23 wherein said secondary bias and said secondary diaphragm are adapted to limit the pressure in said secondary regulator chamber to a predetermined level greater than said given level.

25. A device according to claim 24 wherein said secondary reference chamber is vented to the atmosphere.

* * * * *

United States Patent [19]

Stevens

[11] **Patent Number: 4,945,940**

[45] **Date of Patent: Aug. 7, 1990**

[54] **TAMPER PROOF BACKFLOW PREVENTION ASSEMBLY**

[76] Inventor: **Robert B. Stevens**, P.O. Box 26284, Honolulu, Hi. 96825

[21] Appl. No.: **396,113**

[22] Filed: **Aug. 21, 1989**

[51] **Int. Cl.**[5] **F16K 24/00**

[52] **U.S. Cl.** **137/218**; 137/382.5

[58] **Field of Search** 137/382.5, 218; 251/292

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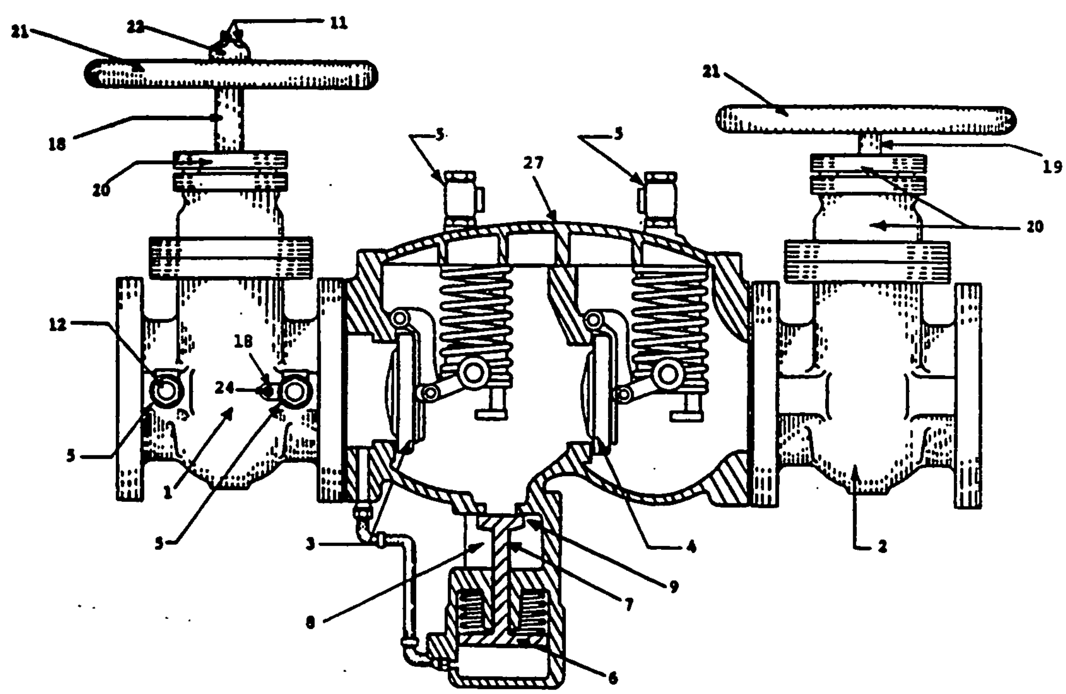
Primary Examiner—Gerald A. Michalsky

[57] **ABSTRACT**

A testable backflow prevention assembly provided with a means for preventing unauthorized access to water within the assembly throughout the differential pressure gradient of the assembly; comprising: a means for locking the valves of the test cocks, a means for lockably securing the test cocks to the backflow prevention assembly body, and a means for preventing cessation of water pressure within the backflow prevention assembly.

9 Claims, 5 Drawing Sheets



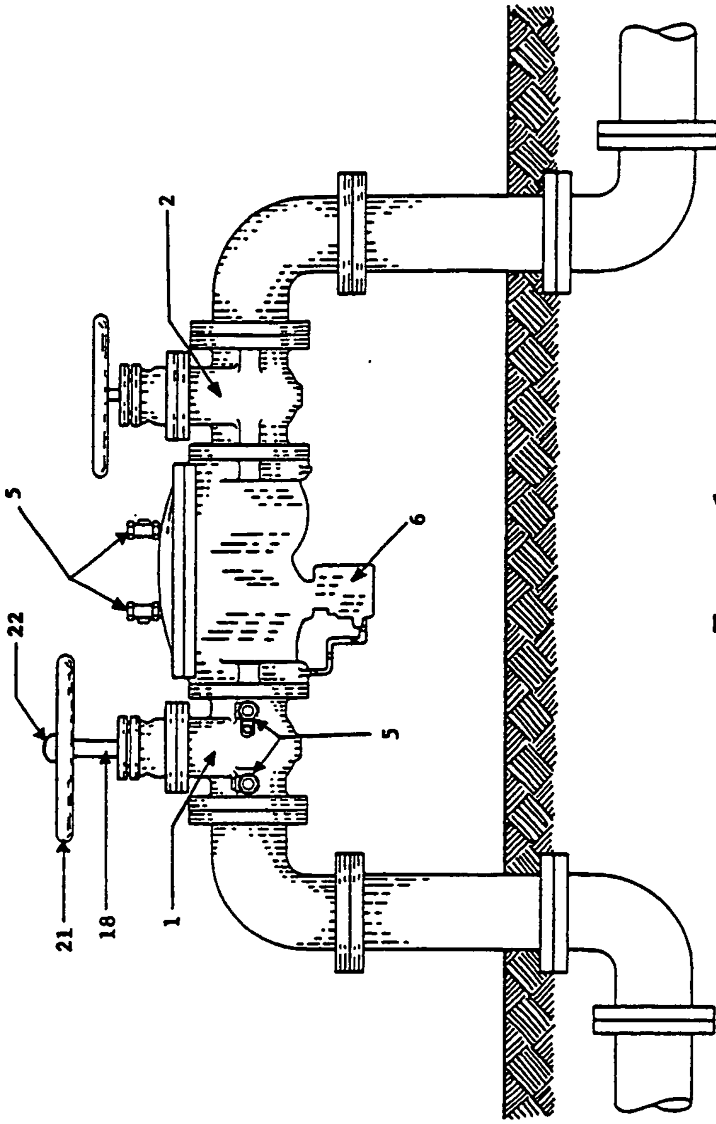


FIG. 1

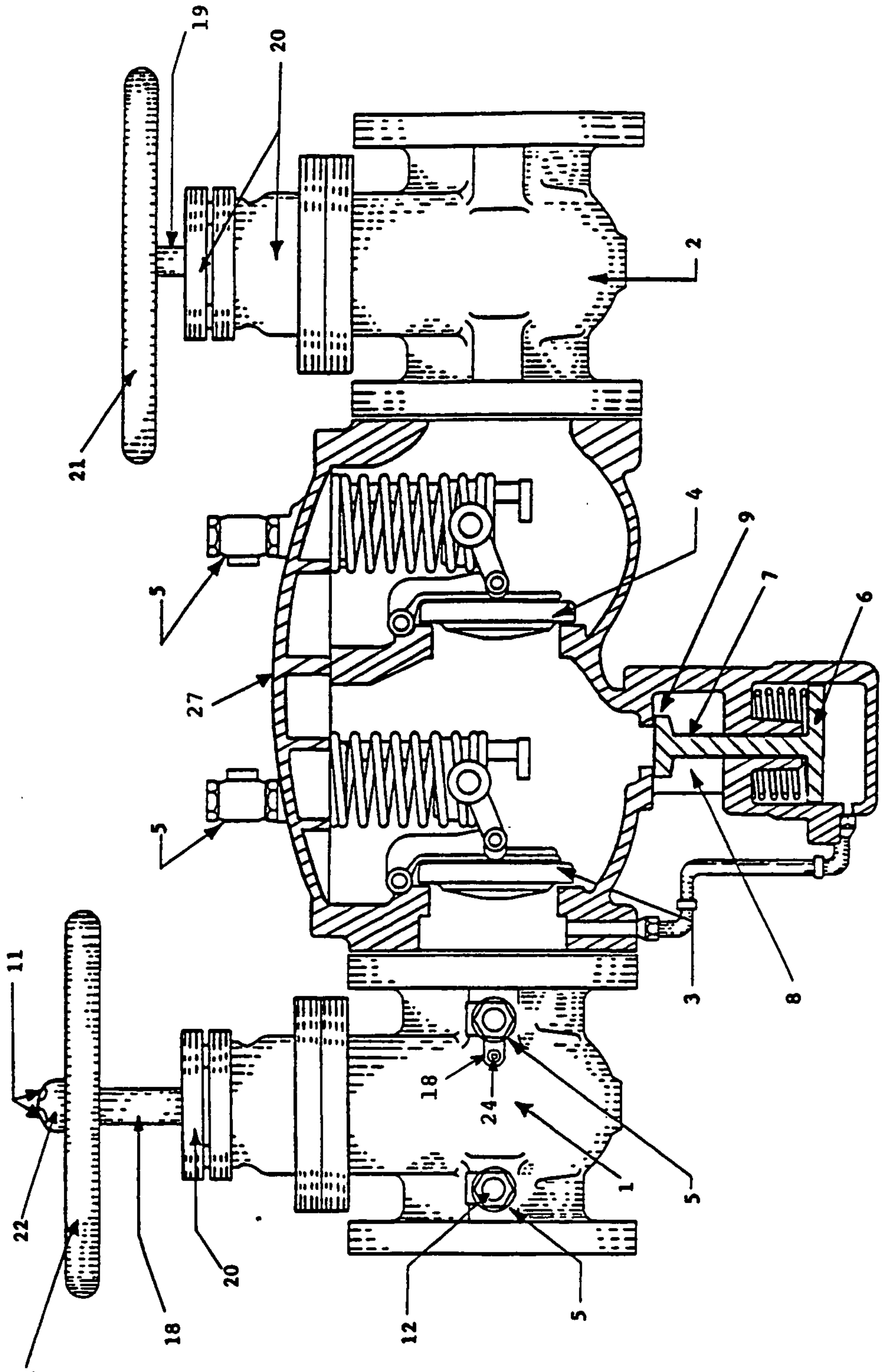


FIG. 2

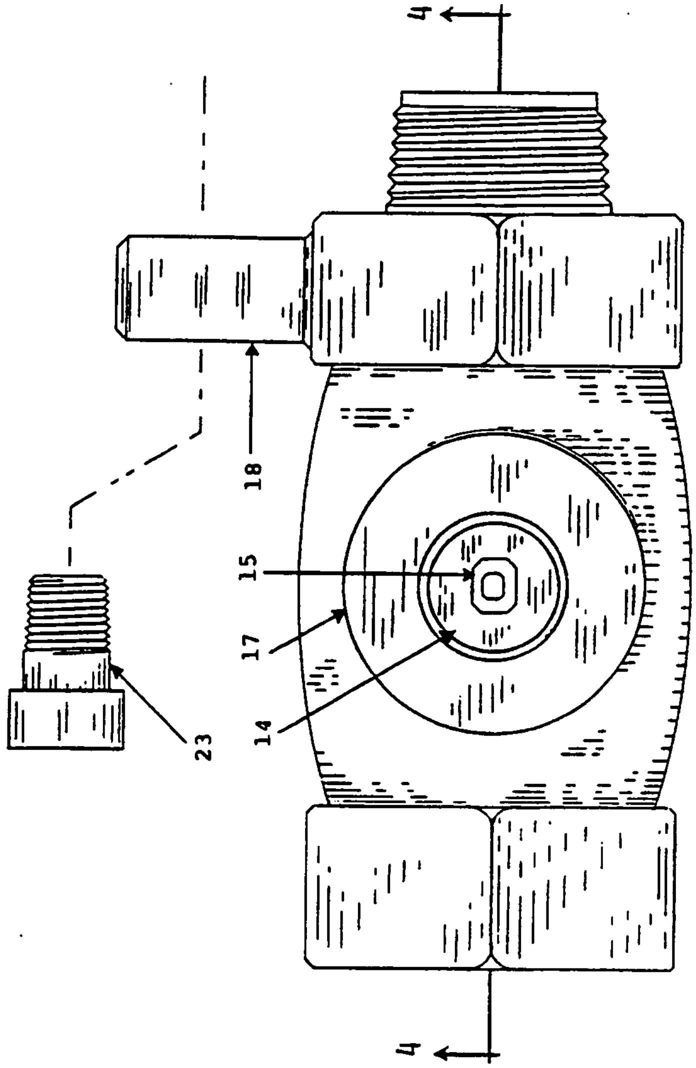
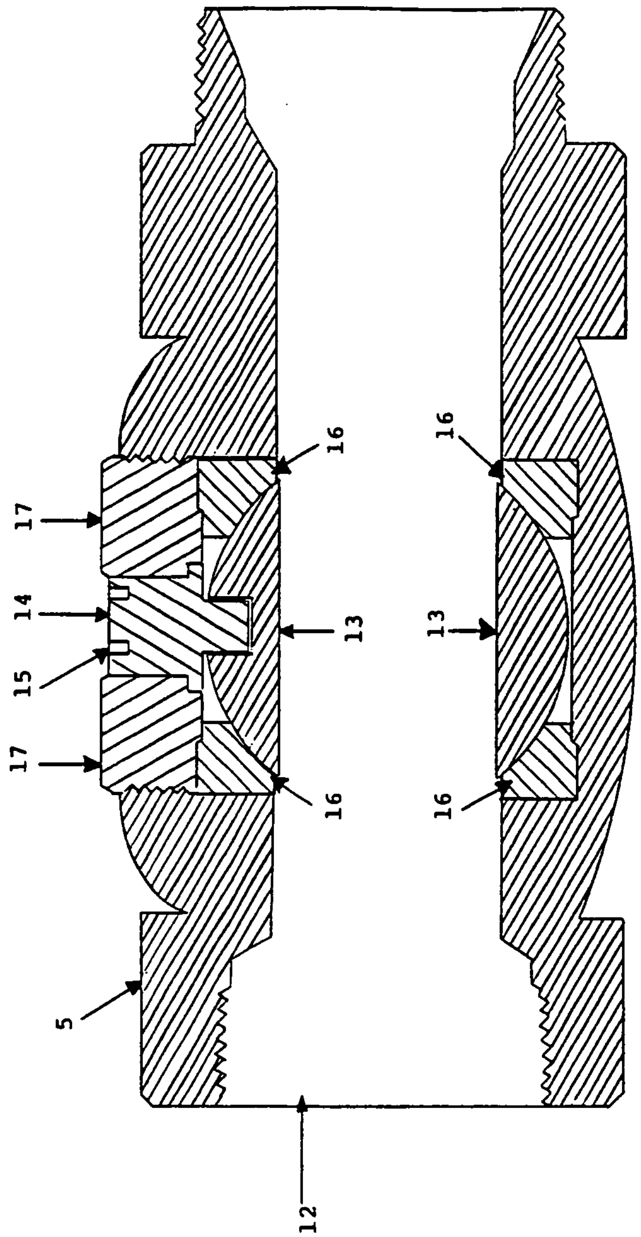


FIG. 3



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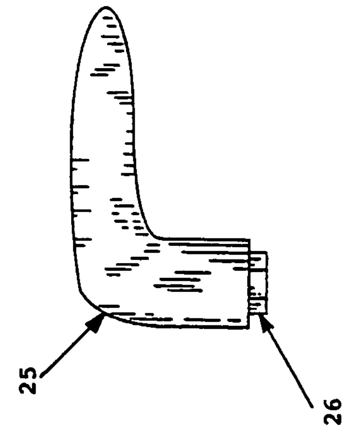

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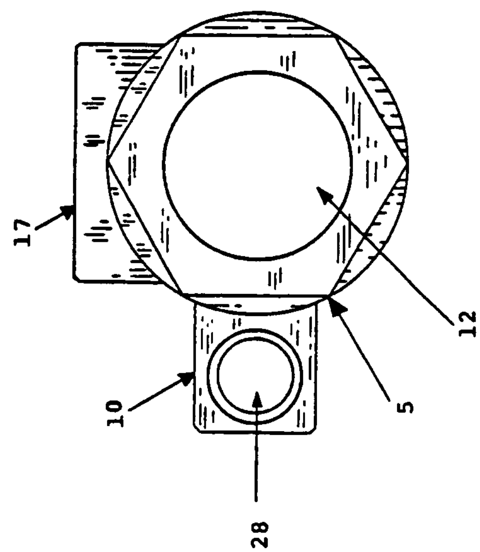

FIG. 5

TAMPER PROOF BACKFLOW PREVENTION ASSEMBLY

BACKGROUND OF THE INVENTION

1. Field of Invention

This invention relates to testable potable water backflow prevention assemblies and the risk of contamination to a potable water supply they pose by virtue of the differential pressure gradient inherent to these devices and the ease with which one may access the water along the differential pressure gradient. This invention prevents unauthorized access to the potable water supply along the differential pressure gradient of testable backflow prevention assemblies.

2. Description of the Prior Art

Testable backflow prevention devices are installed on potable water lines to prevent contamination of the drinking water supply. They are commonly installed after the water meter serving facilities such as high-rise buildings, shopping malls, hospitals, schools, airports, dairies, bottling plants, farms, laboratories, pharmaceutical plants, nursing homes, military bases and commercial and industrial complexes.

Testable backflow prevention devices work by means of multiple check valves and, often, additional devices. There is a differential pressure across any properly operating check valve assembly. Test cocks are located before and after each check valve in testable devices; so as to make sure they are operating properly and will prevent backflow of potentially contaminated water. Although test cocks are intended only for testing the device, and then only by authorized technicians, their significance and function is not generally understood. It is common to see hose bibs and other connections made directly to the test cocks; although such connections are strictly prohibited by water purveyors. These devices are sometimes by-passed, either intentionally or inadvertantly, by connecting two or more test cocks by a common hose or pipe. The hazard of such connections is generally not perceived but is usually substantial. This "Tamper-Proof Backflow Prevention Assembly" is specifically designed to mitigate this hazard as well as provide a suitable level of backflow prevention.

U.S. Pat. No. 3,173,439 to D. G. Griswold et al, shows the operation of a reduced pressure principle backflow preventer; generally considered a very protective type of testable backflow prevention device. There is a differential pressure gradient along this type of backflow prevention assembly and three of the four test cocks along this device will show a different level of pressure. U.S. Pat. No. 3,724,487, to Hunter, and U.S. Pat. No. 3,918,477, to Grams, are examples of some other backflow prevention assemblies.

The concept of safety sealing is not new. U.S. Pat. No. 2,069,849 to P. Rich, illustrates a protector cap for a spigot. With respect to security, locking devices of all sorts have been made; including the mortise and tenon types used to lock such things as automobile wheel rims to fire hydrant caps. More applicable to this patent application is U.S. Pat. No. 3,090,218 to H. A. Birkness. However the application and type of "Locked Safe Valve" of H. A. Birkness is substantially different in several respects. Most notably, it is not specific to or made a part of a backflow prevention assembly. Furthermore, it covers only a specific type of valve and

locking mechanism, not found in backflow prevention assembly test cocks or this application.

My previous U.S. patent application titled "Water Access Preventer", Ser. No. 254,574, Filed Oct. 7, 1988, now U.S. Pat. No. 4,878,515, is the first to address the subject of mitigating the risk of contamination of potable water within testable backflow prevention assemblies. The "Water Access Preventer" is a retrofit device for existing testable backflow prevention assemblies. Unlike my previous "Water Access Preventer", this new patent application is for a totally new, and complete, tamper-proof, backflow prevention assembly. Disclosure document No. 211783 of September 1988 discloses essential elements of the "Water Access Preventer" mentioned above as well as this new "Tamper-Proof Backflow Prevention Assembly."

SUMMARY OF THE INVENTION

An object of the invention is to prevent unauthorized access to the water within a testable backflow prevention assembly.

A further object of the invention is to prevent siphonage of contaminated fluid into the drinking water supply.

A further object of the invention is to prevent contamination of a potable water line.

A further object of the invention is to prevent unauthorized use of water.

A further object of the invention is to maintain pressure throughout the differential pressure gradient of a testable backflow prevention assembly.

A further object of the invention is to prevent discharge of water through improper shut-off of a testable backflow prevention assembly.

A further object of the invention is to prevent theft of all or part of a testable backflow prevention assembly.

A further object of the invention is to be inconspicuous.

Other objects and advantages of the invention will become apparent from the following description.

BRIEF DESCRIPTION OF THE DRAWINGS

In order that the invention may be more readily understood, reference will now be made to the accompanying drawings which show one embodiment thereof by way of example and in which:

FIG. 1 is a front elevation view showing a typical installation.

FIG. 2 is a front elevation view in partial section.

FIG. 3 is a top elevation view of a test cock.

FIG. 4 is a side sectional view of a test cock taken along line 4—4 of FIG. 3.

FIG. 5 is a front elevation view of a test cock.

FIG. 6 is an elevation view of the tenon key.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Before explaining the present invention in detail it is to be understood that the invention is not limited in its application to the accompanying drawings, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also, it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not limitation.

Referring now to the drawings wherein like reference numerals refer to like and corresponding parts of throughout the several views, the preferred embodi-

ment of the invention is disclosed in FIG. 1 through 6 inclusive.

The invention includes an upstream gate valve 1, downstream gate valve 2, between which is located a primary check valve 3, secondary check valve 4 and a zone differential pressure sensing valve 6 that monitors the pressure differential across the primary check valve 3, and, when this differential pressure decreases to within a given value, opens a relief valve 7 that discharges water between the primary check valve 3 and secondary check valve 4 through a discharge port 8, and allows air to enter through the air inlet valve 9 thereby preventing back siphonage.

Upstream of the upstream gate valve 1 is a test cock 5 that provides direct access to the water within the device. Another test cock 5 is located between the upstrean gate valve 1 and the primary check valve 3. Another test cock 5 is located between the primary check valve 3 and the secondary check valve 4. Another test cock 5 is located between the secondary check valve 4 and the downstream gate valve 2. Due to the pressure gradient across the check valves, if a hose were connected to two or more test cocks, water would flow through the hose and entrain any liquid connected to the hose system. The variety of potential hazardous connections is numerous.

A test cock 5 comprises a test cock opening 12, ball valve 13, ball valve stem 14, ball valve seat 16, ball valve retainer 17, and the ball valve stem mortise 15 which prevents the test cock's ball valve stem 14 from being turned without the tenon key 25 which has a tenon 26 designed to mate with the ball valve stem mortise 15. This same tenon 26 may be used to secure the stem lock nut 22 with a stem lock nut mortise 11 to a gate valve stem 19 which prevents the gate valve handle 21 from being removed or the tubular extension sleeve 18 from being removed; the tubular extension sleeve 18 having a primary role of preventing closure of the upstream gate valve 1 which lies within the gate valve housing 20. To prevent the removal of a test cock 5 the securing bolt 23 locks the test cock 5 to the backflow prevention assembly body 27 by securing the test cock flange 10. The securing bolt 23 lies within the flange foramina 28 of the test cock flange 10 thereby preventing its removal without a tenon key 25. A tenon key 25 with tenon 26 that mates with the securing bolt mortise 24 of the securing bolt 23 is required to remove a test cock 5 from the backflow prevention assembly body 27.

I claim as my invention:

1. A testable backflow prevention assembly, provided with a means to access the water within the assembly by those authorized such access, comprising: an upstream gate valve, a primary check valve, a secondary check valve, a zone differential pressure sensing valve, a relief valve, a discharge port, a downstream gate valve, a test cock located upstream of the upstream gate valve, a test cock located between the upstream gate valve and the primary check valve, a test cock located between the primary check valve and the secondary check valve, and a test cock located between the secondary check valve and the downstream gate valve; wherein said test cocks are equipped with a locking valve such that a key is required to unlock and open the valve of the test cock, and, wherein, the test cocks are locked to the backflow prevention assembly body by means of a locking mechanism, said locking mechanism requiring a key in order to permit removal of a test cock from the backflow prevention assembly body.

2. The testable backflow preventing assembly of claim 1, wherein the locking valves of said test cocks are comprised of: a valve stem which actuates the valve of the test cock, wherein the valve stem is equipped with a mortise that mates with a tenon key such that the valve stem can not be moved without the tenon key.

3. The testable backflow prevention assembly of claim 1, wherein the means for locking a test cock to the backflow prevention assembly body comprises: a flange on the test cock for a securing bolt, a securing bolt with a securing bolt mortise which secures the test cock to the backflow prevention assembly body, said securing bolt requiring a tenon key for removal from the backflow prevention assembly body, thereby facilitating removal of said test cock.

4. A testable backflow prevention assembly, provided with a means to access the water within the assembly by those authorized such access, comprising: an upstream gate valve, a primary check valve, a secondary check valve, a downstream gate valve, a test cock located upstream of the upstream gate valve, a test cock located between the upstream gate valve and the primary check valve, a test cock located between the primary check valve and the secondary check valve, and a test cock located between the secondary check valve and the downstream gate valve; wherein said test cocks are equipped with a locking valve such that a key is required to unlock and open the valve of the test cock, and, wherein, the test cocks are locked to the backflow prevention assembly body by means of a locking mechanism, said locking mechanism requiring a key in order to permit removal of a test cock from the backflow prevention assembly body.

5. The testable backflow prevention assembly of claim 4, wherein the locking valves of said test cocks are comprised of: a valve stem which actuates the valve of the test cock, wherein the valve stem is equipped with a mortise that mates with a tenon key such that the valve stem can not be moved without the tenon key.

6. The testable backflow prevention assembly of claim 4, wherein the means for locking a test cock to the backflow prevention assembly body comprises: a flange on the test cock for a securing bolt, a securing bolt with a securing bolt mortise which secures the test cock to the backflow prevention assembly body, said securing bolt requiring a tenon key for removal from the backflow prevention assembly body, thereby facilitating removal of said test cock.

7. A testable backflow prevention assembly, provided with a means to access the water within the assembly by those authorized such access, comprising: an upstream gate valve, a primary check valve, an air inlet valve, a downstream gate valve, a test cock located between the upstream gate valve and the primary check valve, and a test cock located between the primary check valve and the air inlet valve; wherein said test cocks are equipped with a locking valve such that a key is required to unlock and open the valve of the test cock, and, wherein, the test cocks are locked to the backflow prevention assembly body by means of a locking mechanism, said locking mechanism requiring a key in order to permit removal of a test cock from the backflow prevention assembly body.

8. The testable backflow prevention assembly of claim 7, wherein the locking valves of said test cocks are comprised of: a valve stem which actuates the valve

of the test cock, wherein the valve stem is equipped with a mortise that mates with a tenon key such that the valve stem can not be moved without the tenon key.

9. The testable backflow prevention assembly of claim 7, wherein the means for locking a test cock to the backflow prevention assembly body comprises: a flange on the test cock for a securing bolt, a securing bolt with a securing bolt mortise which secures the test cock to the backflow prevention assembly body, said securing bolt requiring a tenon key for removal from the backflow prevention assembly body, thereby facilitating removal of said test cock.

* * * * *

United States Patent [19]
Brewer et al.
[11] Patent Number: 4,991,622
[45] Date of Patent: Feb. 12, 1991

[54] MULTIPLY CONFIGURABLE BACKFLOW PREVENTER

[75] Inventors: John L. Brewer; Gary A. McCauley, both of Clovis, Calif.

[73] Assignee: CMB Industries, Fresno, Calif.

[21] Appl. No.: 454,776

[22] Filed: Dec. 19, 1989

[51] Int. Cl.[5] F16K 17/00
[52] U.S. Cl. 137/512; 137/271; 285/181
[58] Field of Search 137/512, 614.2, 269, 137/271; 285/168, 181, 184

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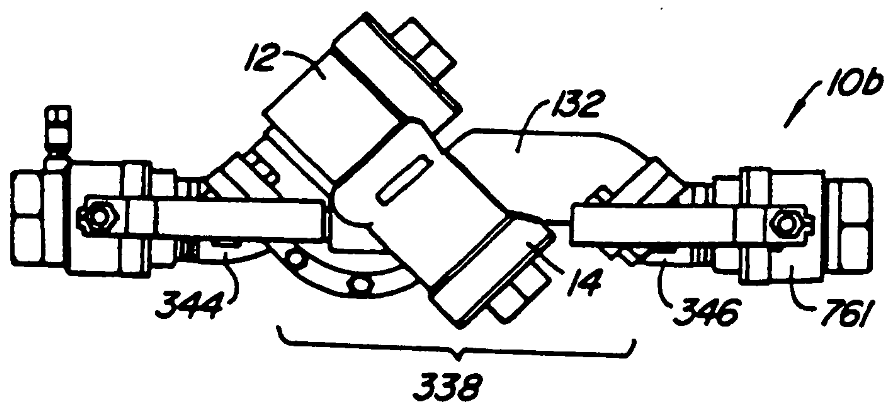
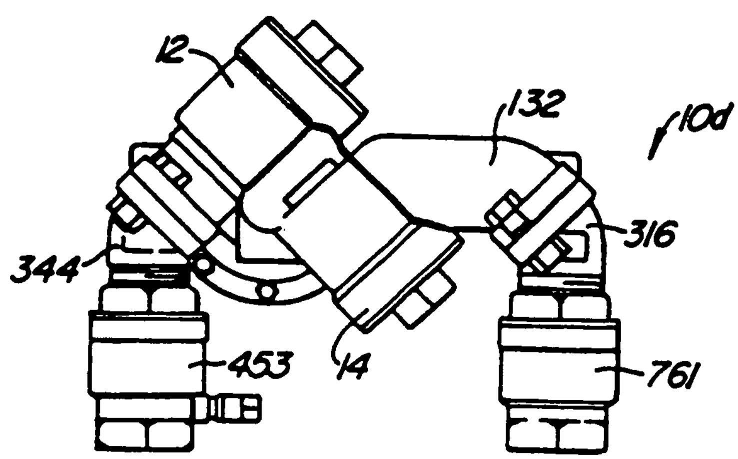
Primary Examiner—John C. Fox
Attorney, Agent, or Firm—Townsend and Townsend

[57] ABSTRACT

A backflow preventer assembly is provided, which allows for connection of the assembly to the variety of water line configurations. The valve device is attached to at least one rotatable, sealing flange which is rotatable from an in-line configuration to an L-shaped configuration. A rotating sealing flange is provided at each of the inlet opening and outlet opening of the valve device. A stop valve is positioned in each of the rotating flanges.

3 Claims, 3 Drawing Sheets





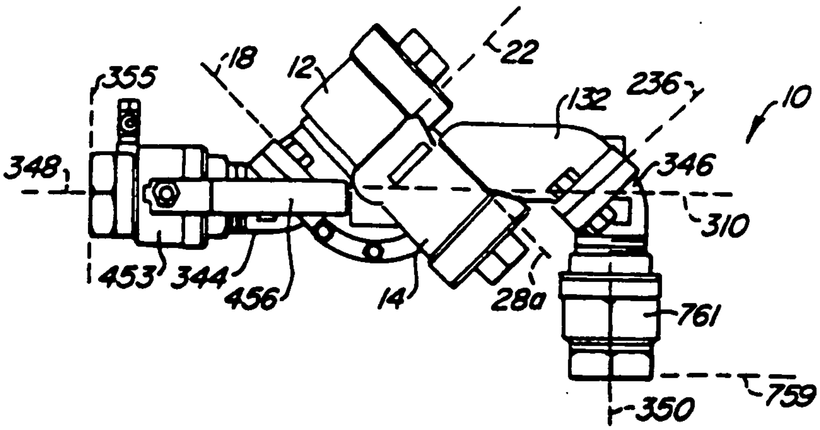


FIG._1A.

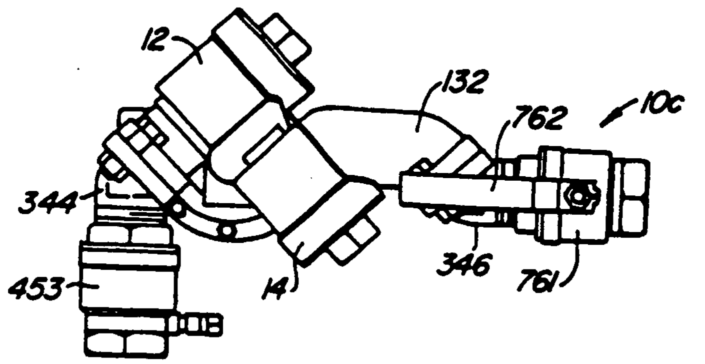


FIG._1B.

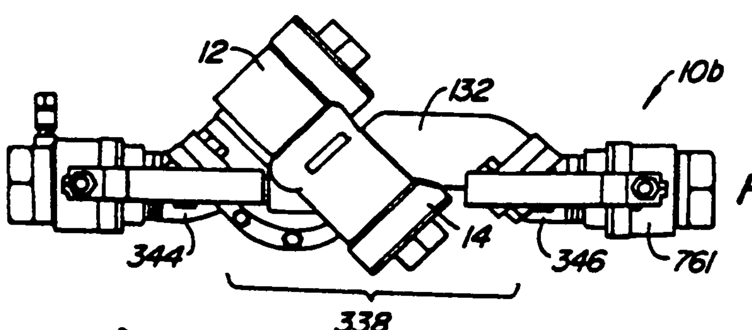


FIG._1C.

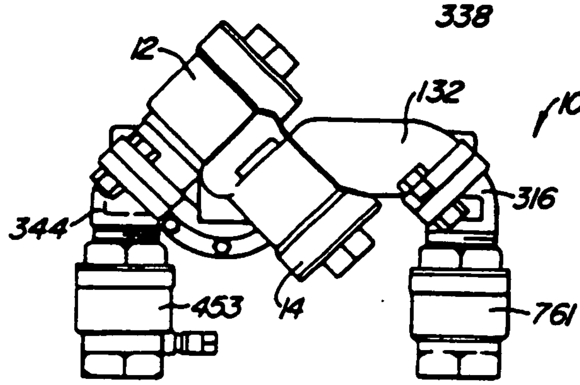


FIG._1D.

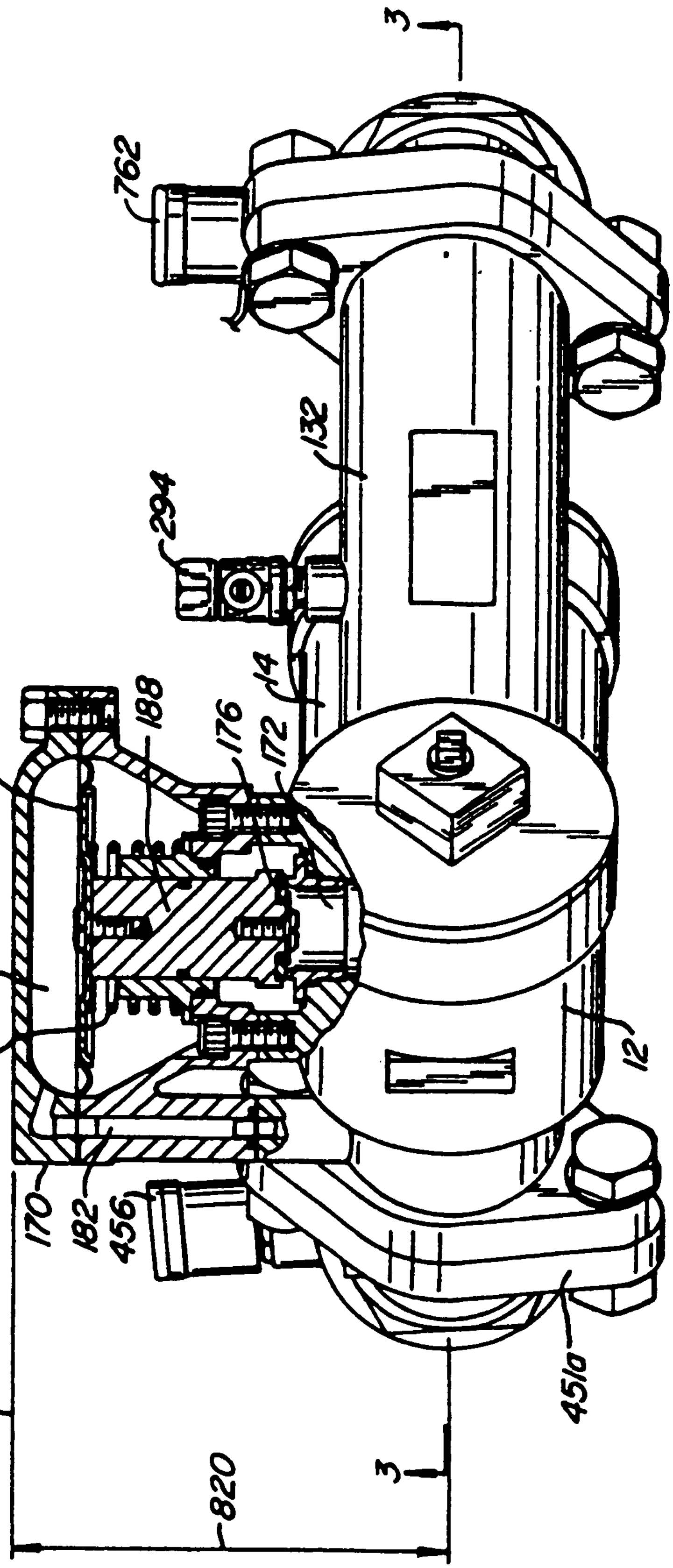

3
762
294
132
14
176
172
186
188
178
192
12
170
182
456
4510
822
820
3

FIG._2

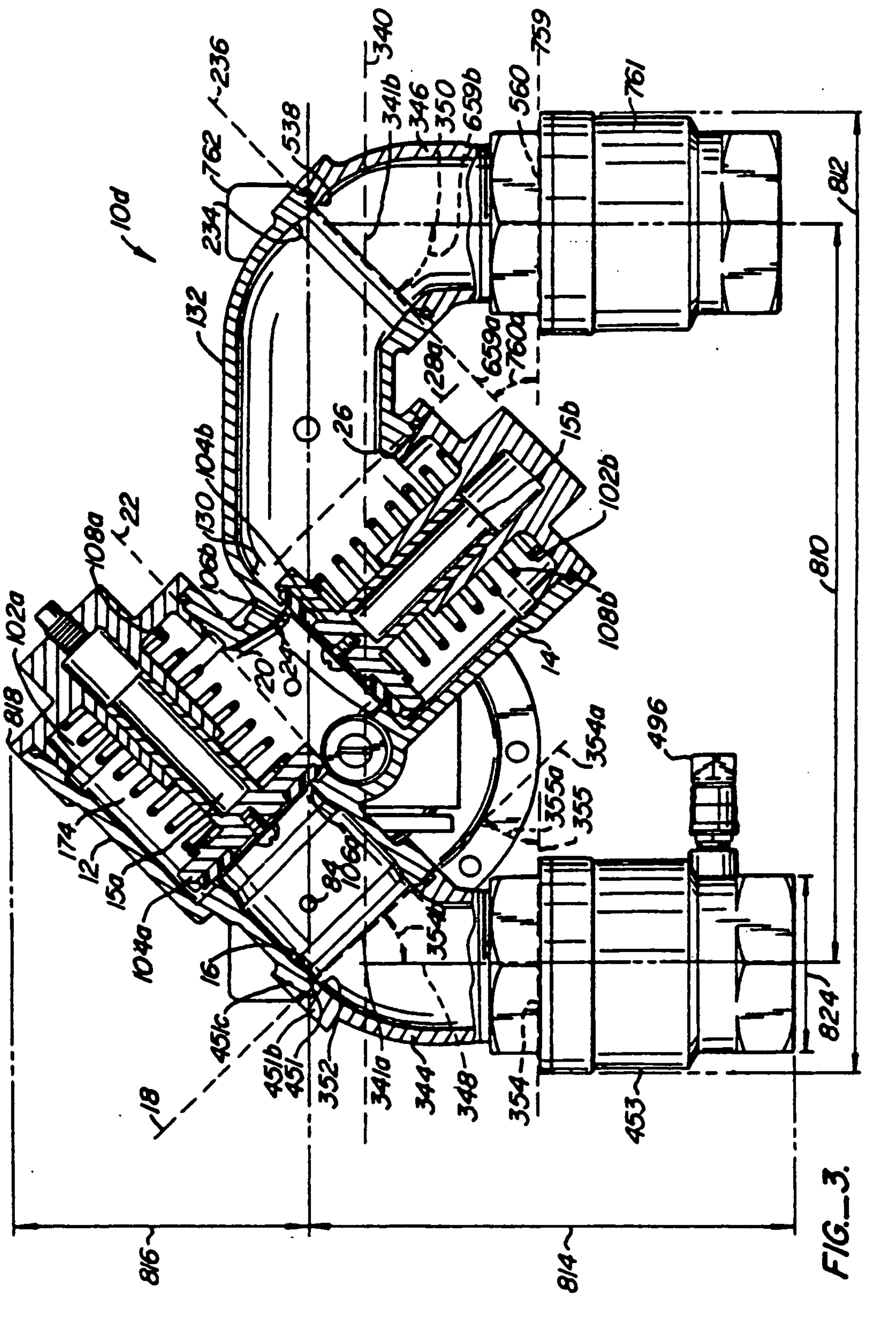


FIG._3.

MULTIPLY CONFIGURABLE BACKFLOW PREVENTER

BACKGROUND OF THE INVENTION

The present invention relates to a backflow preventer which can be placed in a multitude of configurations, and particularly to a backflow preventer with rotatble inlet and outlet fittings.

Check valves are well known for use in assuring that a flow through a conduit occurs only in a predefined direction. Check valves are used, for example, in backflow prevention assembly to prevent backflow of one fluid body into another. Backflow prevention is used in connection with protecting potable water supplies from contaminants which could otherwise be introduced via back siphonage or back pressure. Backflow valves thus are check valves which are designed to accommodate pressures commonly encountered in water supplies, such as about 150 psi or more.

Typically, a check valve is designed to maintain its open configuration as long as there is flow through the valve. Once the flow stops or the line pressure drops below a predetermined value, the check valve closes.

Check valves are typically provided with an inlet opening and an outlet opening, but having only a single predefined configuration of the inlet and outlet openings. Accordingly, when such a backflow preventer is to be installed in a water line, various couplings, fittings, elbows, and the like are used to install the backflow preventer such that the outlet from the water line can be matingly connected to the backflow preventer inlet, and so that the backflow preventer outlet can be matingly connected to the downstream water line. When upstream or downstream stop valves are desired, they are provided as components which must be separately installed. The requirement for such elbows, fittings, valves, and the like creates a number of costs in connection with installation of previous backflow preventers. There is a materials cost in providing such couplings, fittings, etc. There is also a labor cost involved in selecting the appropriate couplings and fittings from the large number which are available, and installing these fittings to mate the backflow preventer with the water line. There is further a maintenance cost, because each coupling which must be added to achieve the desired configuration represents a potential point of leakage.

Typical previous backflow preventers are connected to water lines in an in-line or right-angle position. This connection configuration makes it relatively easy to defeat the backflow preventer using straight line, 90° elbow or spool connectors. Therefore, in previous systems, there was a problem with users removing backflow preventer and replacing them with piping, e.g., to reduce pressure head loss or, during backflow, prevent maintenance or repair, thus endangering the water supply.

SUMMARY OF THE INVENTION

The present invention includes the recognition of the problems of previous backflow preventers, and particularly the requirement for selection, installation, and maintenance of additional couplings, fittings, and the like. According to the present invention, a backflow preventer assembly is provided which has movable components so that the assembly can be placed in a number of configurations to provide for ease of installation or removal from a water line. At least one fitting is provided which is rotatable about its opening from a first in-line configuration to a second perpendicular configuration. Preferably, the backflow preventer assembly includes one such rotatable fitting at the backflow preventer inlet and another at the backflow preventer outlet. In this way, the assembly can be placed in an in-line configuration, first and second L-shaped configurations, and a U-shaped configuration. By providing fittings which lie in a non-standard 45° configuration, undesirable replacement of backflow preventers with non-preventing pipes is made more difficult and is thus discouraged.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1A is a side elevational view of the backflow preventer in a first L-shaped configuration;

FIG. 1B is a side elevational view of the backflow preventer assembly in a second L-shaped configuration;

FIG. 1C is a side elevational view of the backflow preventer assembly in an in-line configuration;

FIG. 1D is a side elevational view of the backflow preventer assembly in a U-shaped configuration;

FIG. 2 is a top plan view of the device of FIG. 1D; and

FIG. 3 is a cross-section taken along line 3—3 of FIG. 2.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. 1A depicts the backflow preventer assembly of the present invention in a first L-shaped configuration **10**. A first valve housing **12** and a second valve housing **14** are used to house first and second backflow preventer valves **15a**, **15b**. A number of types of backflow preventer valves are usable as generally known in the art. One example of such a valve is that shown in FIG. 3.

Each of the housings **12**, **14** is in the form of a conduit. The first housing **12** has a first opening **16** (FIG. 3) lying in a first plane **18**, and a second outlet opening **20** lying in a second plane **22**. The second plane **22** is perpendicular to the first plane **18**. The second housing **14** has an inlet opening **24** lying parallel to the second plane **22**. The second housing **14** has an outlet opening **26** lying in a third plane **28a**.

Inside each of the first and second housings **12**, **14** is a valve, the valves being configured to operate as a check valve system. As is well known in the art, a number of types of valves can be used for check valve purposes. In the depicted embodiment, the inlet check valves **102a**, **102b** include valve disks **104a**, **104b** which are urged toward valve seats **106a**, **106b** by springs **108a**, **108b**. When flow stops or the line pressure drops below a predetermined value, the check valves **102a**, **102b** are forced into the closed position depicted in FIG. 3 by the springs **108a**, **108b**. When the line pressure exceeds a predetermined value, it overcomes the urging of the springs **108a**, **108b**, and the check valves **102a**, **102b** open, permitting the flow through the valve opening **16** through the first check valve **102a**, out of the exit opening **20** through the entrance opening **24** of the second check valve **102b**, through the second check valve and out the exit opening **130** to enter the conduit **132**.

As depicted in FIG. 2, a relief valve **170** extends outward from the first valve housing **12**. The relief valve **170** is provided in order to discharge possibly

contaminated water into the atmosphere, to prevent its entering the water source. The relief valve 170 is optional in the sense that a backflow preventer can be designed which does not include a relief valve 170. When a relief valve is included, a number of configurations can be used, as is well known in the art. In the configuration depicted, an inlet opening 172 is in fluid communication with the interior volume 174 of the first check valve. In the closed configuration of the relief valve depicted, a seating disk, such as a nitrile disk, 176 seats against the edge of the opening 172 by virtue of water pressure in an upper chamber 178. The upper chamber 178 is in fluid communication with the region upstream of the first check valve via a conduit 182, which connects with an opening 184 in the first valve housing 12. A diaphragm 186 forces a spring-loaded piston 188 into the closed position depicted in FIG. 2. When the pressure at the upstream location 182 falls below a predetermined level with respect to the pressure in the valve interior 174, such as a pressure differential of about 3 psi (about 20 kPa), the spring 192 causes the piston 188 to move away from the opening 172 to permit discharge of water to the atmosphere.

A valve conduit 132 (FIG. 1A) leads away from the outlet 26 of the second valve housing 14. The valve conduit 132 has a first opening 130 which lies in the third plane 28*a*. The valve conduit 132 is preferably fixedly attached to the second housing 14, such as by welding, bolting, clamping, or by integral formation therewith. The valve conduit 132 has a second opening 234 lying in a fourth plane 236. The fourth plane 236 is parallel to the second plane 22 and perpendicular to the first plane 18 and third plane 28*a*. A first test cock 294 is connected to the conduit 132 in order to provide a position for pressure testing, e.g., by connecting a differential pressure gauge.

The first housing 12, second housing 14, and valve conduit 132 form a valve device 338 whose inlet is the inlet opening 16 of the first valve housing 12, and whose outlet is the outlet 234 of the valve conduit 132. The inlet and outlet openings 16, 234 are preferably circular in shape. The valve device inlet and outlet openings 16, 234 define a first longitudinal axis 340 of the valve device 338 which passes through the centroids 341*a*, 341*b* of the valve device openings 16, 234. The plane of the inlet opening 18 and the outlet opening 236 are disposed at an angle, with respect to each other, of about 90°.

Attached to the inlet and outlet openings 16, 234 of the valve device 338 are first and second fittings 344, 346. Each of the fittings 344, 346 has a longitudinal axis 348, 350. The first fitting 344 has first and second openings 352, 354. The first opening 352 of the first fitting 344 lies in a plane 354*a* which meets the longitudinal axis 348 at an angle 354*b* of about 45°. The first opening 352 of the first fitting 344 lies in the same plane 18 as the valve device input opening 16. The second opening 354 is in a plane 355 perpendicular to the longitudinal axis 348. The plane of the second opening 355 is thus inclined to the plane of the first opening 18 at an angle 355*a* of about 45°.

The first fitting 344 is attached to the valve device 338 by a rotatable mating relationship between the inlet opening 16 of the valve device 338 and the first opening 352 of the first fitting 344. An O-ring 451 provides a leakproof seal. The first fitting 344 and valve device 338 are held together in a sealing relationship by a bolt clamp 451*a* (FIG. 2) which compresses the respective flanges 451*b*, 451*c* of the first fitting 344 and valve device 338. This connection provides for rotation of the first fitting 344 with respect to the valve device 338 by loosening or removing the bolt clamp 451*a*, rotating the fitting 344, and retightening bolt clamp 451*a* by tightening the bolts passing through the bolt clamp 451*a*. In this way, a number of different configurations of the first fitting 344 with respect to the valve device 338 are obtained while maintaining the 45° orientation of the axis 348 with respect to the first plane 18, and providing for a fluid seal.

In the preferred embodiment, a stop valve 453 is disposed inside or upstream from the first fitting 344. Although in FIG. 1*a*–1*d*, the stop valve 453 is depicted as attached colinearly with and upstream from the first fitting 344, in another embodiment of the present invention, the stop valve 453 is formed as an integral part of the fitting 344. The stop valve can be any of a number of well known valve designs, including a ball valve, a gate valve, or, preferably, a globe valve. Preferably, the stop valve 453 can be manually opened or closed by moving an external handle 456. A second test cock 496 is provided upstream of the stop valve 453 in order to provide a position for pressure testing.

The second fitting 346 has first and second openings 558, 560, with the first opening 558 attached to the outlet opening 234 of the valve device 338. The first opening 558 lies in a plane 659*a*, which is inclined to the longitudinal axis 350 at an angle 759*b* of about 45°. The plane 759 of the first opening 558 lies in the plane of the valve device outlet opening 236. The plane 59 of the second opening 355 is perpendicular to the longitudinal axis 350. The plane of the second opening 759 is thus inclined to the plane of the first opening 236 at an angle 760*a* of about 45°.

The second fitting 346 is rotatably and sealingly attached to the outlet opening 234 of the valve device 338 in a manner similar to the attachment of the first coupling 344 to the valve device 338 depicted in FIG. 3.

The second fitting 346 preferably has disposed therein or downstream therefrom a second stop valve 761 similar to that described above in connection with the first fitting 344, and operable by a handle 762. Although, in the embodiment depicted in FIGS. 1*a*–1*d*, the stop valve 761 is depicted as attached colinearly with and upstream from the second fitting 346, in another embodiment the stop valve 761 is formed as an integral part of the fitting 346.

The configuration depicted in FIG. 1A is useful for attachment of the backflow preventer assembly 10 to water lines (not shown) which are disposed at a 90° angle with respect to each other. In order to connect the backflow preventer assembly to a water line which has an inline configuration, the second fitting 346 is rotated about the valve device outlet opening 234 to assume the in-line configuration 10*b* depicted in FIG. 1C for use in connection with substantially colinear water lines. The in-line configuration can be reconfigured to a second L-shaped configuration 10*c*, as depicted in FIG. 1B, by rotating the first fitting 344 about the valve device opening 16 to assume the configuration shown in FIG. 1B. The configuration of FIG. 1B can be changed to a U-shaped configuration by rotating the second fitting 346 about the valve device outlet opening 234 to assume the configuration 10*d*, depicted in FIG. 1D, for use in connection with substantially parallel water lines.

In the depicted embodiment, a first length 810 is defined by the distance between the axes 348, 350 of the

first and second fittings **344**, **346**. A second length **112** represents the overall length of the device, including the stop valves **453**, **761**. A first height **814** is defined by the distance from the lowermost extent of the stop valves **453**, **761** to the uppermost extent of the first and second fittings **344**, **346**. A second height **816** is defined by the distance from the uppermost point of the first and second fittings **344**, **346** to the uppermost extent **818** of the device. A first depth clearance **820** is defined by the distance from the longitudinal axis **340** to the outwardmost extent **822** of the relief valve **170**. The value of the various dimensions for the device will be a function of the nominal water-line fitting diameter **824**, as can be seen in Table 1.

TABLE 1

Nominal Water Line Diameter In Inches (cm)	Device Dimensions In Inches (cm) 1st Length 810	2d Length 812	1st Height 814	2d Height 816	Lateral Clearance 820
¾ (1.90)	10 (25.40)	8½ (21.59)	4⅞ (12.38)	4⅛ (10.48)	4⅛ (10.48)
1 (2.54)	10¼ (26.04)	8½ (21.59)	5¼ (13.34)	4⅛ (10.48)	4⅛ (10.48)
1½ (3.81)	18 (45.72)	11½ (29.21)	6⅞ (17.46)	5¼ (13.34)	5 (12.70)
2 (5.08)	19 (48.26)	11½ (29.21)	7½ (19.05)	5¼ (13.34)	5 (12.70)

A number of variations and modifications of the invention can be used. Backflow preventer valves other than those described can be used, provided they are effective for use as backflow preventers, i.e., provide a check valve function at pressures encountered in potable water supplies. A single backflow preventer valve or three or more backflow preventer valves can be provided in the valve device **338**. The valves can be provided in configurations other than the T-shaped configuration shown, and the valve conduit may not be needed in some of those configurations, as long as the angles of the valve device inlet and outlet openings cooperate with the angles of the rotatable fittings, to produce in-line and L-shaped configurations upon rotation of the fittings.

Although the invention has been described by way of a preferred embodiment and various modifications, other variations and modifications can be used, as will be apparent to those skilled in the art, the invention being described in the following claims.

What is claimed is:

1. A backflow preventer assembly, comprising:

backflow preventer valve means;

a housing for said valve means having a fluid inlet first end and a fluid outlet second end, a first opening formed at one of said first and second ends and a second opening formed at the other of said first and second ends, said first and second openings of said housing lying substantially in first and second planes, said first and second planes being disposed with respect to each other at an angle of about 90°;

a first fitting having a first longitudinal axis and having first and second openings, said first opening of said first fitting lying in a plane which is inclined with respect to said longitudinal axis at an angle of about 45°;

means for sealingly, rotatably joining said first opening of said first fitting to said first opening of said housing to permit rotation of said first fitting with respect to said first opening of said housing;

a second fitting having a second longitudinal axis and having first and second openings, said first opening of said second fitting lying in a plane which is inclined with respect to said second longitudinal axis at an angle of about 45°; and

means for sealingly, rotatably joining said first opening of said second fitting to said second opening of said housing to permit rotation of said second fitting with respect to said second opening of said housing.

2. A backflow preventer assembly, comprising:

backflow preventer valve means;

conduit means containing said valve means, said conduit means having first and second openings, said openings defining a first axis passing substantially through the centroids of said first and second openings;

a first fitting rotatably, sealingly mounted to said first opening, and having a second axis, said first and second axes defining a first plane, rotation of said first fitting causing movement of said first plane;

a second fitting rotatably, sealingly mounted to said second opening, and having a third axis said first and third axes defining a second plane, rotation of said second fitting causing movement of said second plane;

said conduit, first fitting and second fitting forming an assembly which is reconfigurable, as a result of rotation of said first and second fittings, among

a linear configuration wherein said first, second and third axes are substantially parallel;

a first L-shaped configuration in which said first and second axes are substantially parallel and said third axis is substantially perpendicular to said first and second axes;

a second L-shaped configuration in which said second and third axes are substantially parallel and said first axis is substantially perpendicular to said second and third axes; and

a U-shaped configuration in which each of said second and third axes are substantially perpendicular to said first axis.

3. A backflow preventer assembly, comprising:

a first valve means;

a housing for said first valve means, defining a fluid inlet lying in a first plane and a fluid outlet lying in a second plane, said second plane perpendicular to said first plane;

a second valve means;

a housing for said second valve means, defining a fluid inlet lying in said second plane and a fluid outlet lying in a third plane, said third plane parallel to said first plane;

a valve conduit having a first opening lying in said third plane and a second opening lying in a fourth plane, said fourth plane parallel to said second plane;

a first fitting having a first longitudinal axis and having third and fourth openings, said third opening lying in said first plane, said fourth opening lying in a fifth plane, said fifth plane inclined to said first plane at an angle of about 45°, said first fitting sealingly, rotatably joined to said first valve inlet to permit rotation of said first fitting with respect to said first valve inlet; and

a second fitting having a second longitudinal axis and having fifth and sixth openings, said fifth opening lying is said fourth plane, said sixth opening lying in a sixth plane, said sixth plane inclined to said fourth plane at an angle of about 45°, said second fitting sealingly, rotatably joined to said second valve inlet to permit rotation of said second fitting with respect to said second valve outlet;

said first and second valves configured to permit flow from said third opening in a direction towards said sixth opening, and to close to prevent flow in a direction from said sixth opening towards said third opening;

a first stop valve disposed in said first fitting with external means for manually opening and closing said first stop valve; and

a second stop valve disposed in said second fitting with external means for manually opening and closing said second stop valve.

* * * * *

US005107888A

United States Patent [19]

Dunmire

[11] Patent Number: 5,107,888

[45] Date of Patent: Apr. 28, 1992

[54] N-SHAPED BACKFLOW PREVENTOR

[75] Inventor: Charles W. Dunmire, Fresno, Calif.

[73] Assignee: CMB Industries, Inc., Fresno, Calif.

[21] Appl. No.: 650,799

[22] Filed: Feb. 5, 1991

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 435,870, Nov. 13, 1989, Pat. No. 4,989,635.

[51] Int. Cl.^{5} F16K 15/03

[52] U.S. Cl. 137/527; 137/512; 137/614.2; 251/337

[58] Field of Search 137/512, 512.3, 527, 137/527.2, 527.4, 614, 614.2; 251/303, 337

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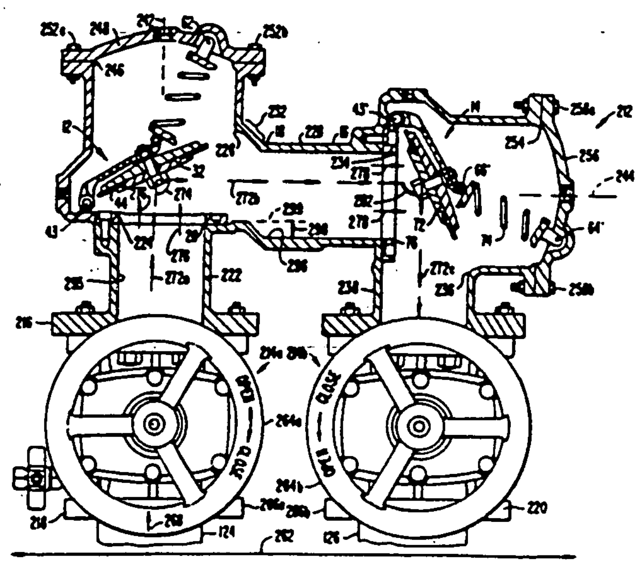
Primary Examiner—John Rivell

Attorney, Agent, or Firm—Townsend and Townsend

[57] **ABSTRACT**

A backflow preventor with increased performance, and increased ease of installation is provided. The check valves are configured to assist in redirecting flow along the desired pathway, when they are in the open position. The pathway is designed so that the number of changes of flow direction of the average streamline flow is reduced, preferably being about 180°. The check valves are configured to reduce or eliminate divergent flow around the edges of the valve disks. A check valve with a reduced hold-open pressure includes a biasing device, such as a spring, directly connected to a pivoting clapper at one end and to the valve body at the other end. No intervening pivoting links are used between the spring and the clapper. Preferably, the clapper is connected only by being pivoted to the valve body and by the spring connecting it to the valve body.

14 Claims, 10 Drawing Sheets



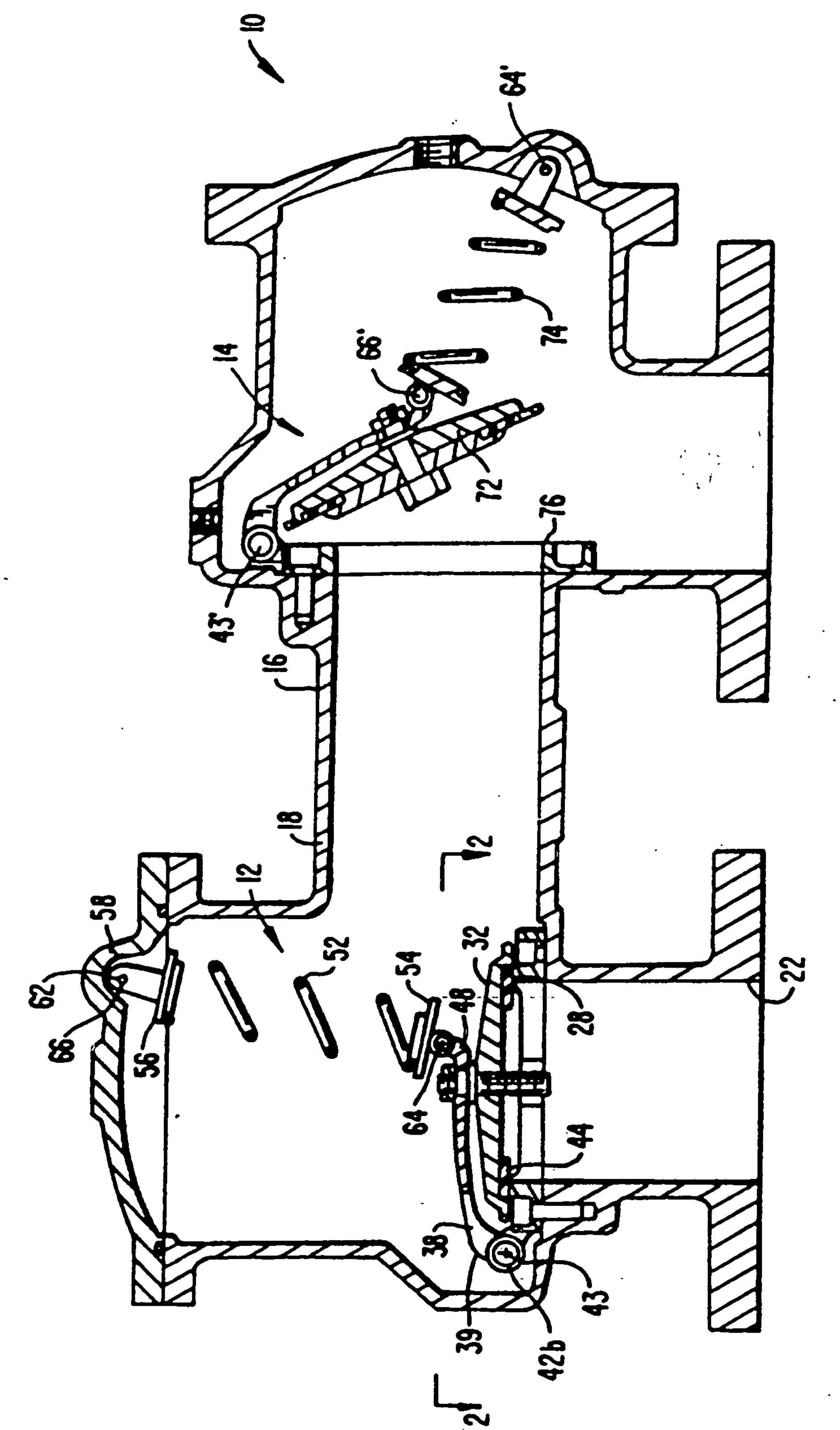

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FIG.—1.

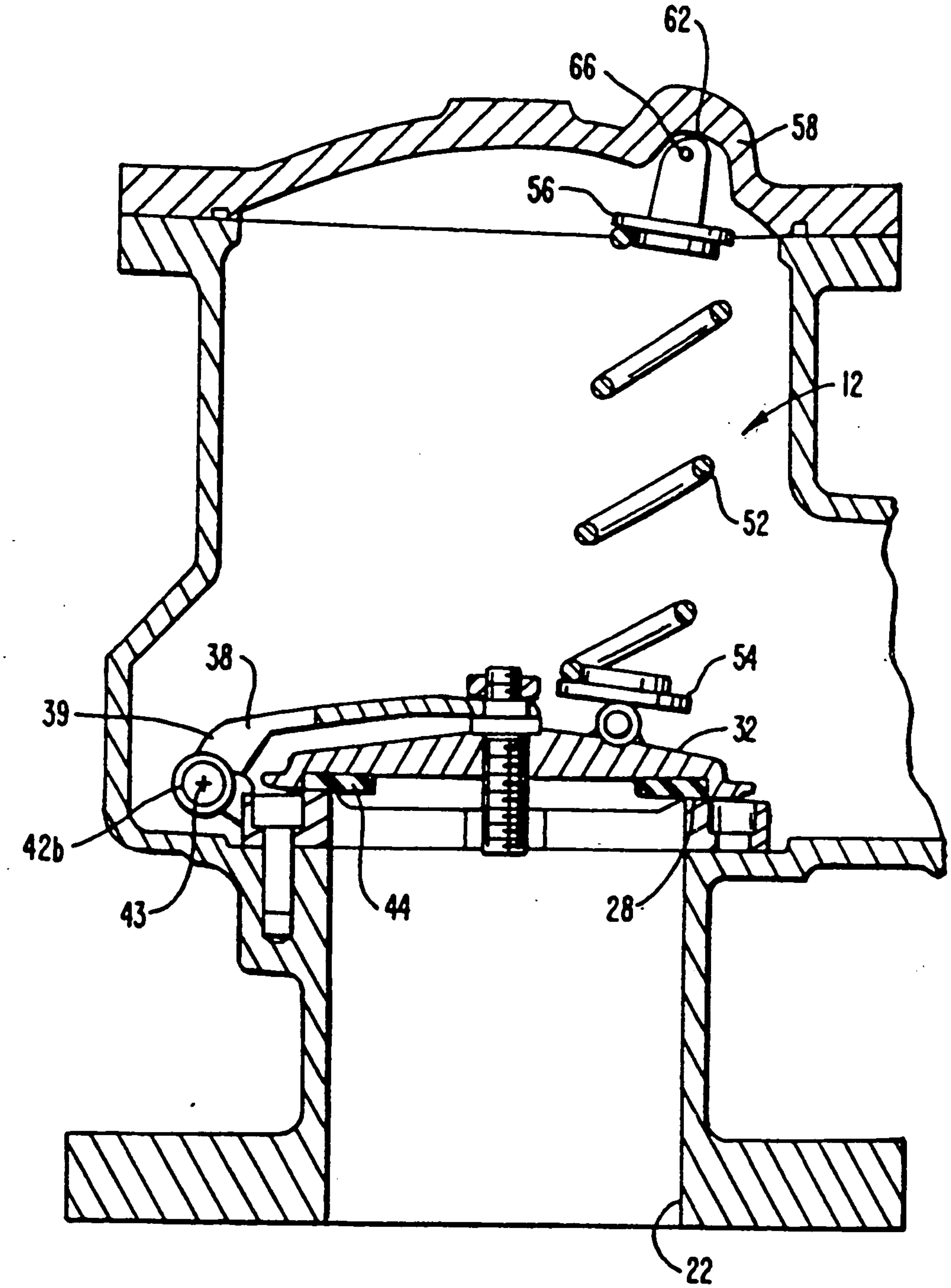

FIG._1A.

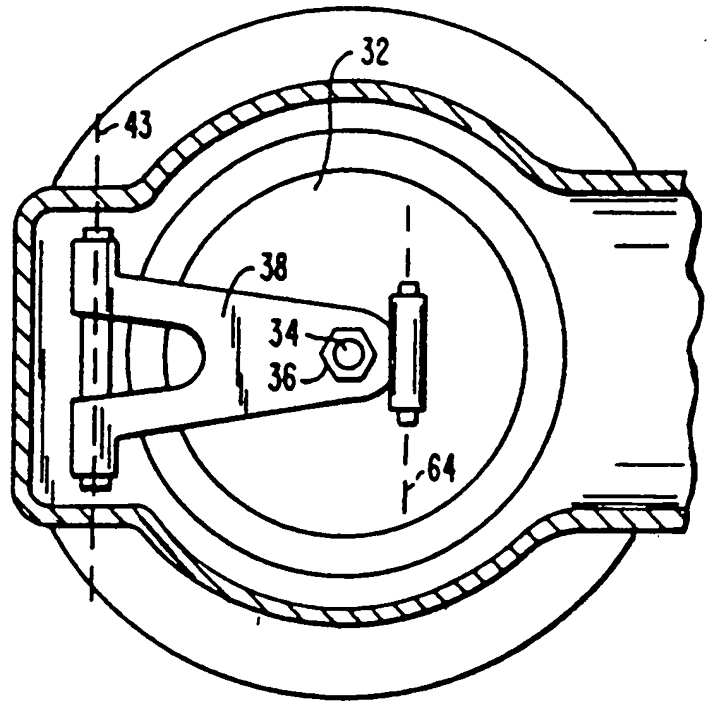

FIG._2.

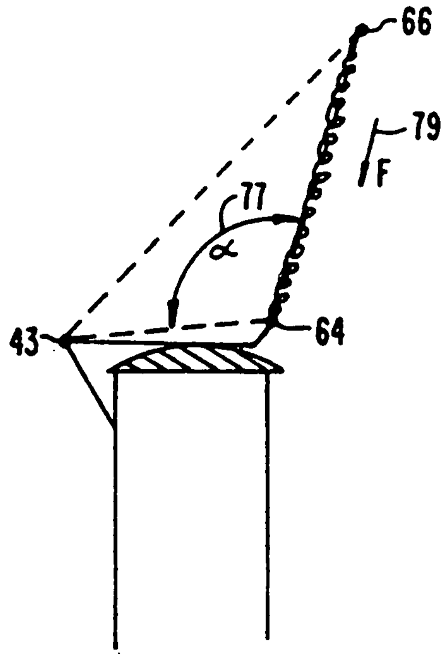

FIG._3A.

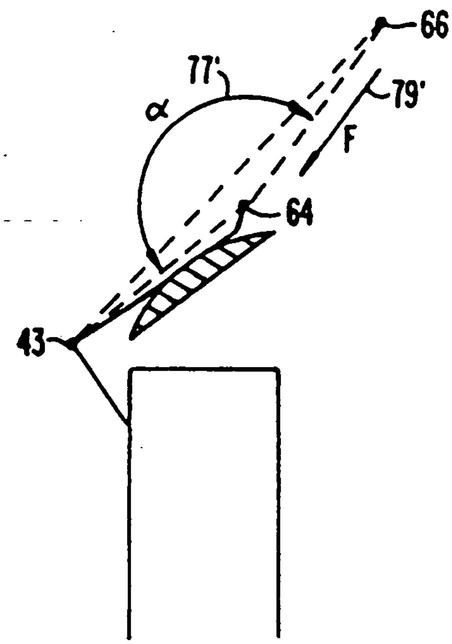

FIG._3B.

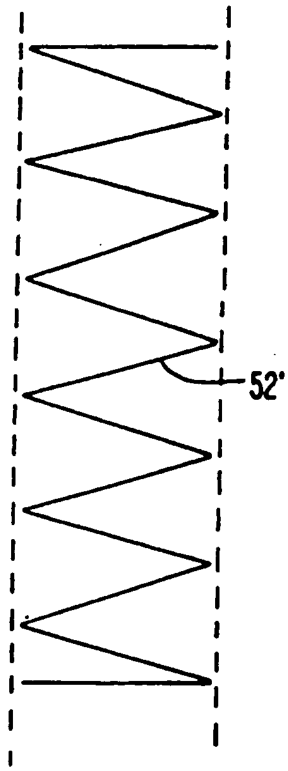

FIG._4A.

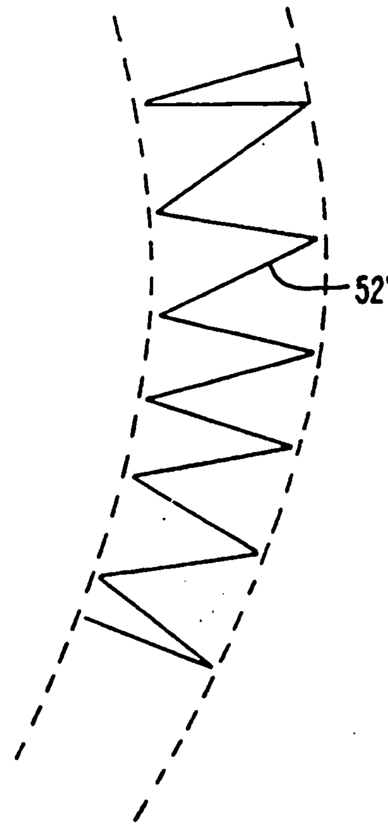

FIG._4B.

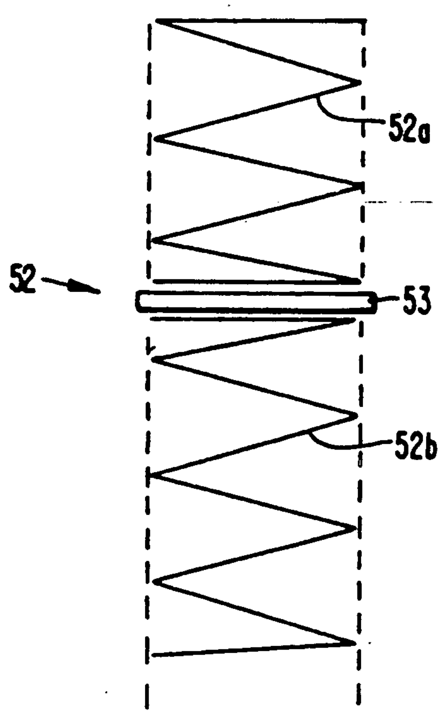

FIG._5A.

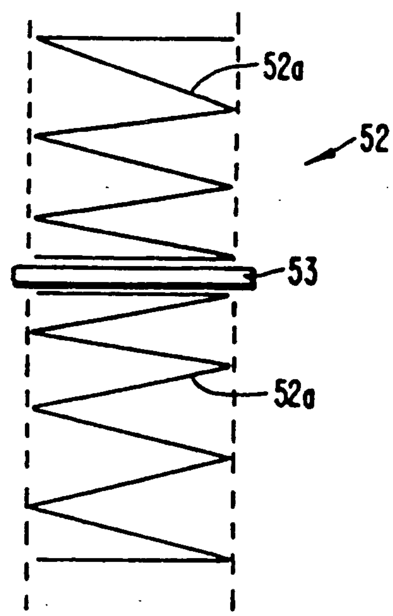

FIG._5B.

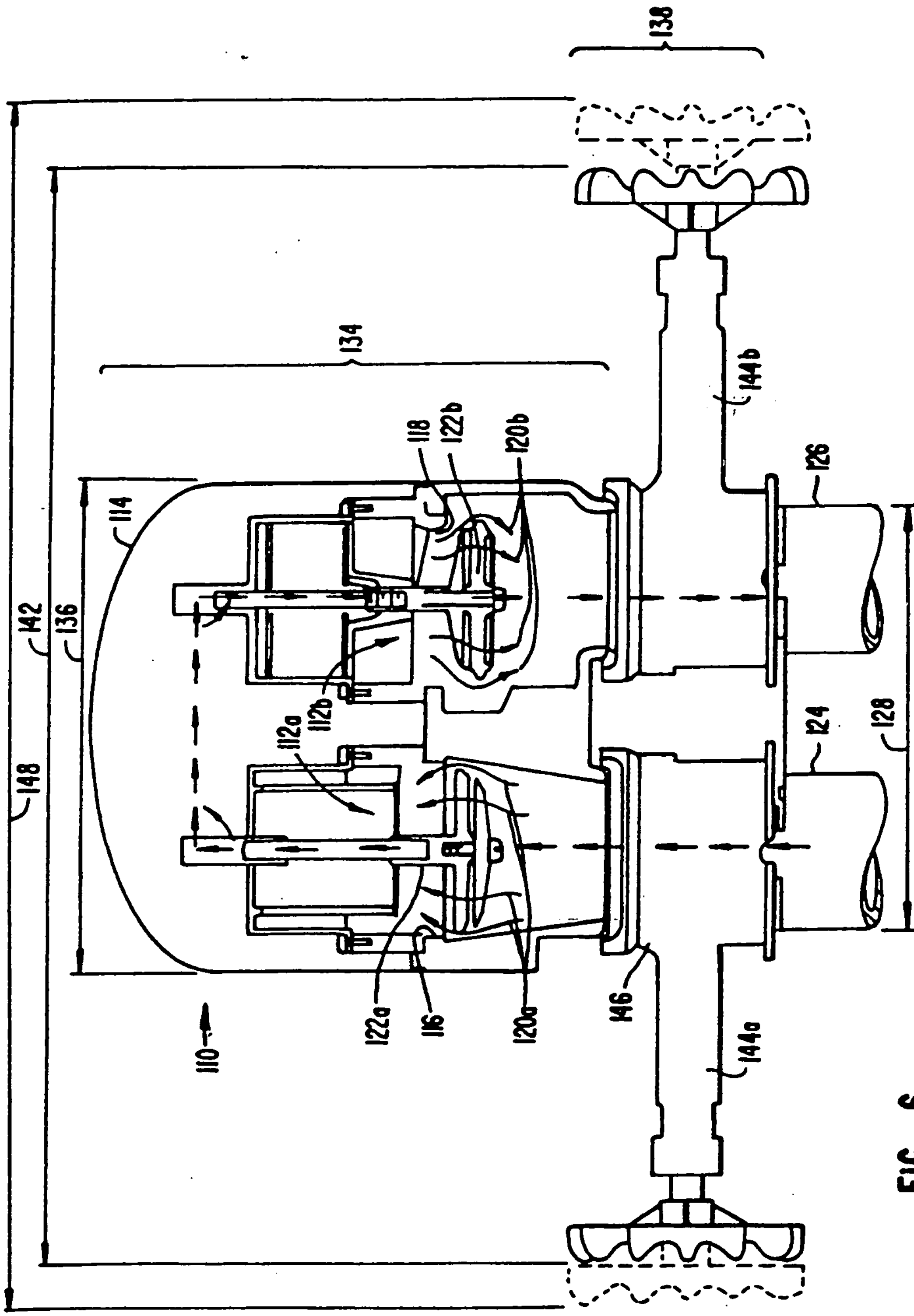

FIG. 6.
PRIOR ART

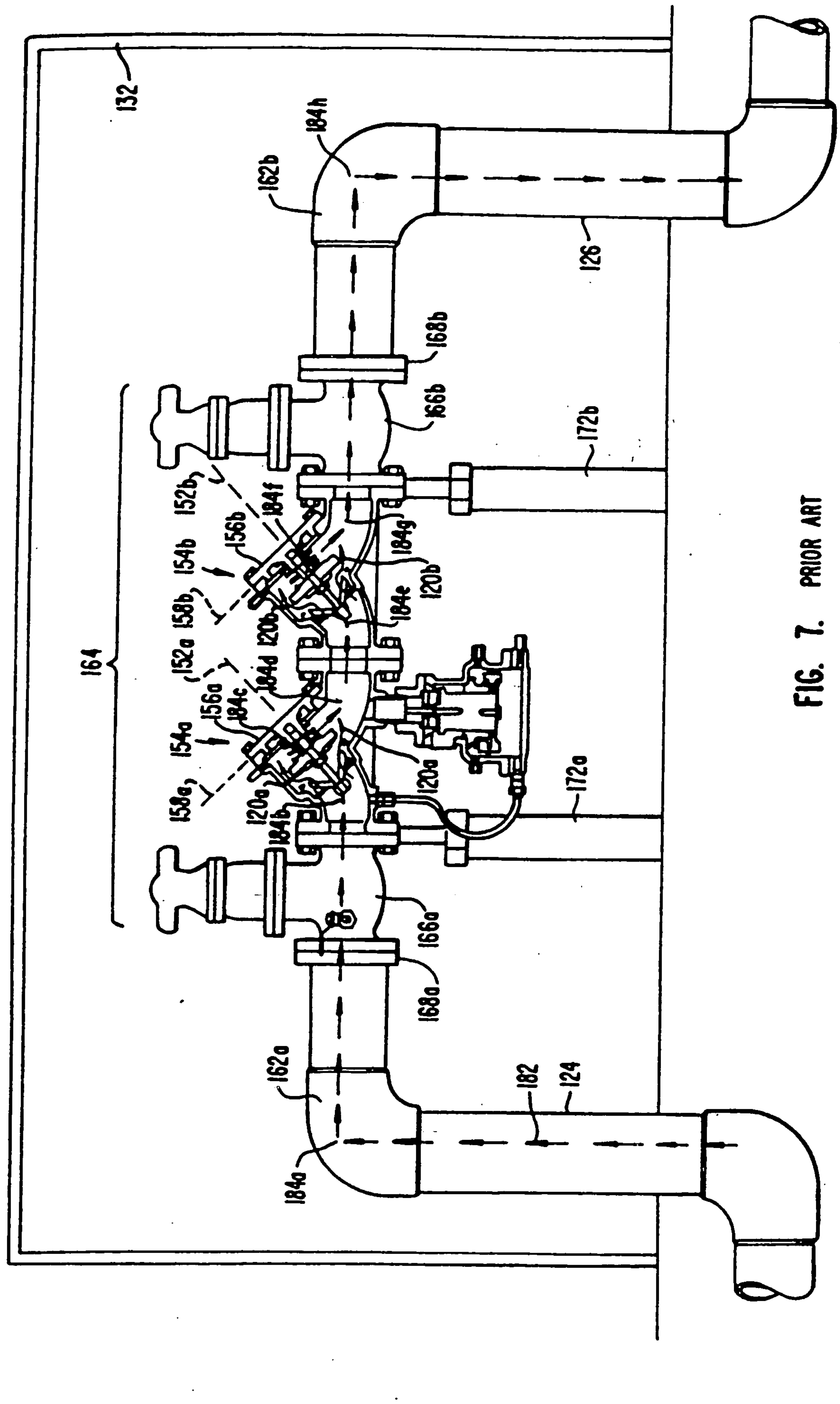

FIG. 7. PRIOR ART

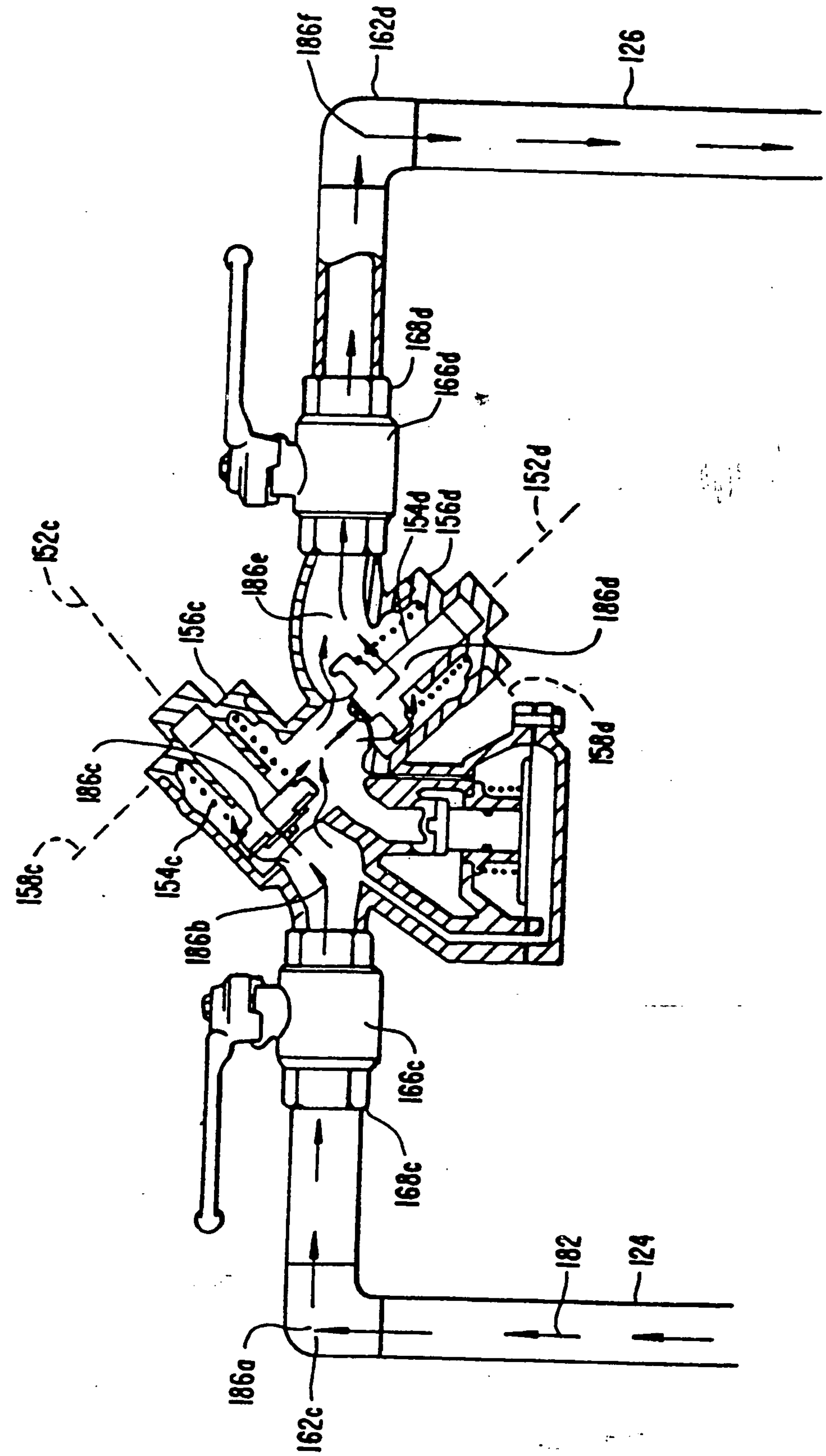

FIG. 8. PRIOR ART

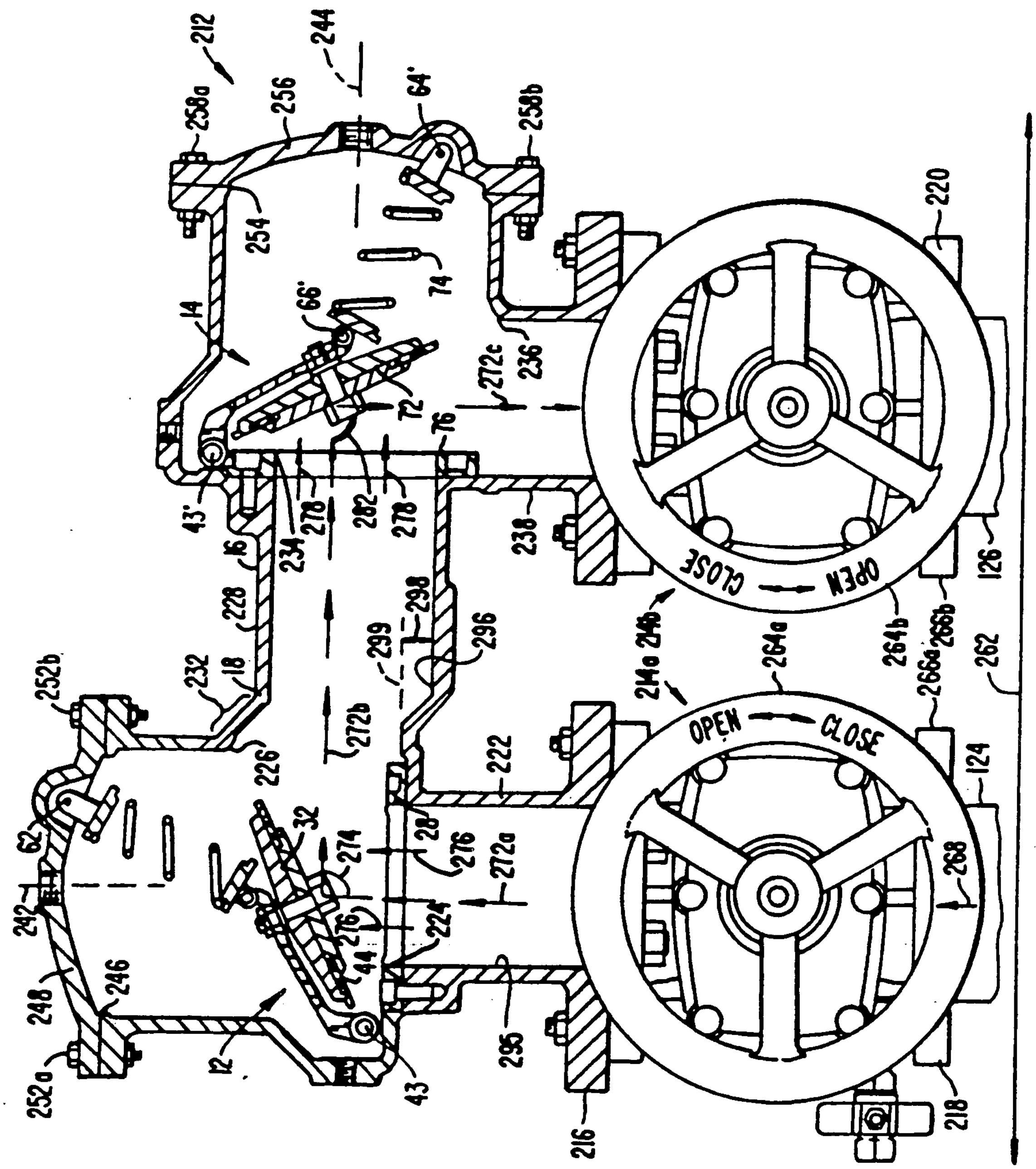
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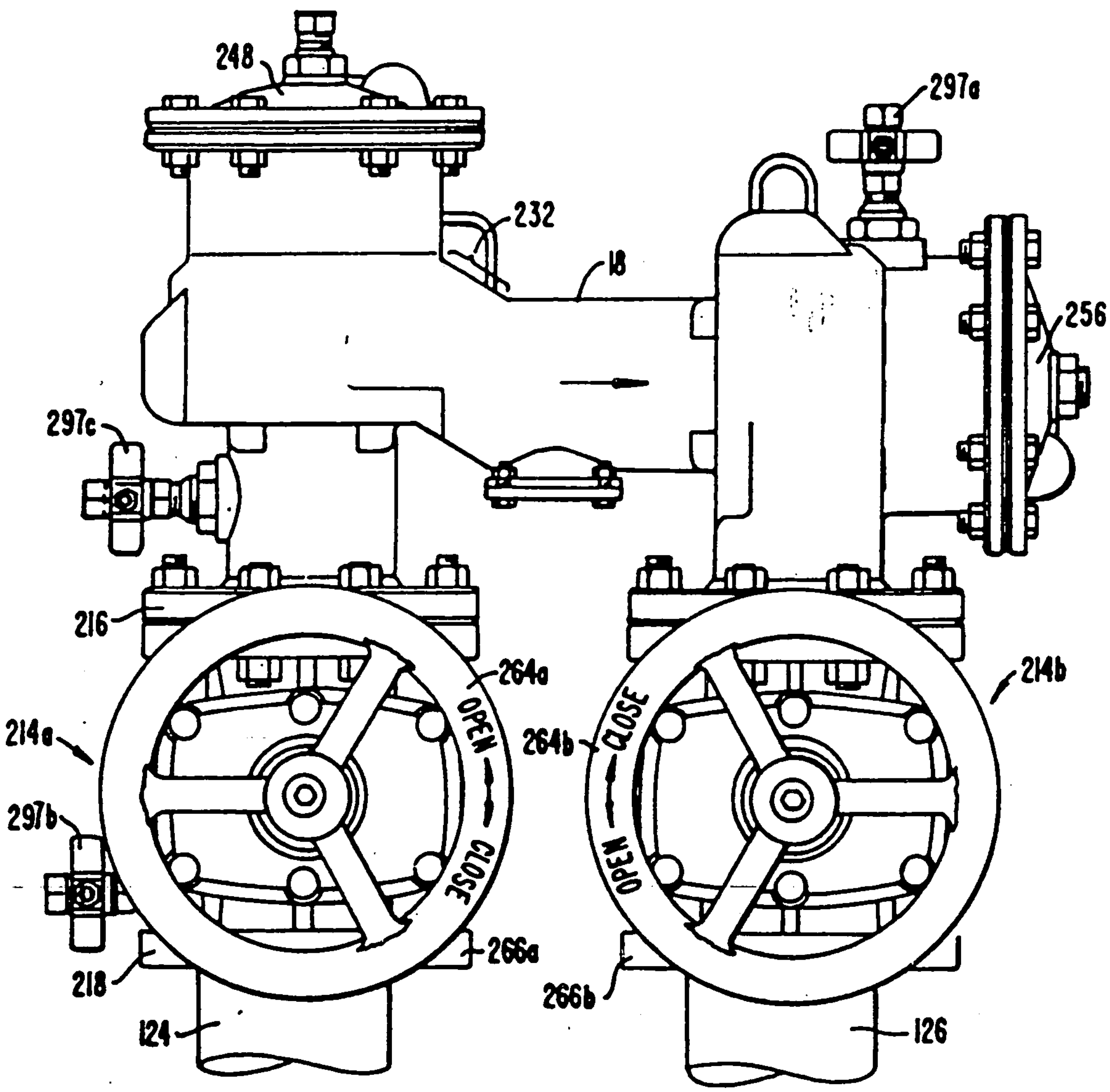
FIG. 9.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218
266b
124
126

FIG. 10.

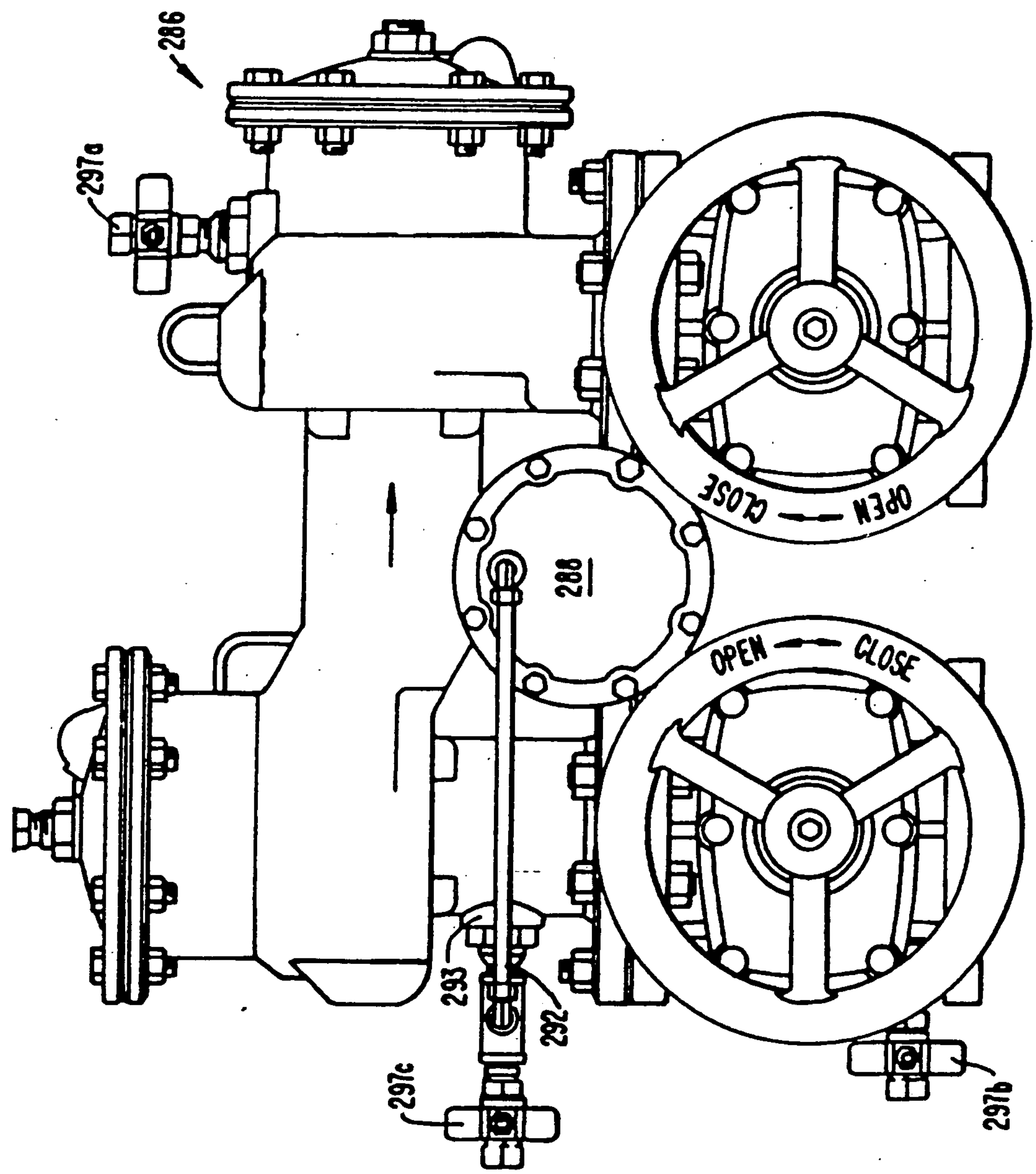


FIG. 11.

N-SHAPED BACKFLOW PREVENTOR

This application is a continuation-in-part of Serial No. 07/435,870, filed Nov. 13, 1989, for Check Valve with Reduced Hold-Open Pressure, to be issued as U.S. Pat. No. 4,989,635 on Feb. 5, 1991.

FIELD OF THE INVENTION

The present invention relates to an N-shaped backflow preventor and, in particular, to a preventor with a housing having a small footprint and high flow efficiency.

BACKGROUND OF THE INVENTION

Check valves are well known for use in assuring that a flow through a conduit occurs only in a predefined direction. Check valves are used, for example, in backflow prevention assemblies to prevent backflow of one fluid body into another. Backflow prevention is often used in connection with protecting potable water supplies from contaminants which could otherwise be introduced into it via back-siphonage or back-pressure. Many backflow preventors are designed to accommodate pressure commonly encountered in municipal water supplies, such as 150 psi (1,030 kPa) or more.

Several factors are important in designing or selecting a backflow preventor for a particular use, including performance (e.g., minimizing pressure drop), serviceability, and ease and cost of installation. In previous devices, maximizing serviceability has been incompatible with also maximizing the performance and installation factors. Thus, in past devices, efforts to increase the performance and ease of installation has produced devices with decreased serviceability. FIG. 6 depicts, schematically, a previous backflow preventor **110** which attempted to provide ease of serviceability by including both valves in **112*a*, 112*b*** in a vertical configuration and a cover **114** which, when removed, permits access to the valves **112*a*, 112*b*** (e.g., for maintenance purposes) in a vertical direction. The device shown in FIG. 6, however, provides a less than optimal performance. This is at least partially because, owing to the orientation of the valves **112*a*, 112*b*** with respect to the inlet opening **116** and outlet opening **118** flow through the valve openings **116, 118** is forced to follow a divergent path (indicated by solid arrow streamlines **120*a*, 120*b***). The blocking action of the valve disks **122*a*, 122*b***, causing this divergent flow **120*a*, 120*b***, provides resistance to flow through the backflow preventor **110** and increases the pressure drop which the backflow preventor produces.

The device depicted in FIG. 6 also has deficiencies from the point of view of installation. In general terms, the cost of installation is least when the backflow preventor occupies the smallest amount of space. Thus, when a backflow preventor is installed in a building, it is desired to minimize the floor space required for installation. When the backflow preventor is installed outside a building, the expense of installation is related to the size of the enclosure required (e.g., enclosure **132** depicted in FIG. 7). When the backflow preventor is installed underground, it is desirable to minimize the size of the trench (not shown) required for underground installation.

As seen in FIG. 6, the inlet conduit and outlet conduit **124, 126** occupy a horizontal distance **128** which determines the minimum amount of space theoretically needed for installation of a backflow preventor. The upper portion **134** of the backflow preventor **110** occupies a horizontal extent **136** which is only slightly greater than theoretically minimum horizontal extent **128** required for installation. However, the lower portion **138** has a minimum horizontal extent **142** which is substantially greater, principally because the handle portions **144*a*, 144*b*** of the shutoff valves extend outward from the housing **146** in a direction which is parallel to the axis of the conduits **124, 126** (i.e., parallel to a line passing through the conduits **124, 126**). Moreover, an even larger horizontal expanse **148** is required to accommodate opening of the shutoff valves since the handles **144*a*, 144*b*** move in a direction parallel to the axis of the conduits **124, 126**.

FIG. 7 depicts another configuration for a backflow preventor which also has certain deficiencies. The axes **152*a*, 152*b*** along which the first and second check valves **154*a*, 154*b*** extend (defined, for these purposes, as a line passing through the center of the inlet port of the valves **154*a*, 154*b*** and parallel to the direction of flow into the valves) are parallel and both extend at an angle of about 45° to vertical. Access for maintenance is obtained by removing covers **156*a*, 156*b*** to provide openings. The openings lie in planes **158*a*, 158*b*** which are inclined to the horizontal by about 45°. Because neither of the openings lies in a horizontal plane, the device does not provide for access in a vertical direction. This represents a drawback to the serviceability of the device in FIG. 7.

Installation of the device shown in FIG. 7 also has certain drawbacks. Installation requires certain additional parts such as 90° elbows **162*a*, 162*b*** to change the flow direction from the upward and downward flow of the inlet and outlet conduits **124, 126** to the horizontal flow direction of a backflow preventor **164**. The size of the enclosure **132** required is relatively large to accommodate the extra parts **162*a*, 162*b*** and since the two shutoff valves **166*a*, 166*b*** and check valves **154*a*, 154*b*** are generally linearly arrayed. Because of the change in flow direction, the flanges **168*a*, 168*b*** for installing the backflow preventor **164** are vertically oriented. This requires provision of supports **172*a*, 172*b*** for supporting and positioning the backflow preventor **164** at least during installation. As with the device depicted in FIG. 6, the check valves **154*a*, 154*b*** of the device in FIG. 7 are of a type requiring that the flow through the valves be divergent **120*a*, 120*b*** around the edges of the valve disks.

FIG. 8 depicts another type of previously-provided backflow preventor also having certain deficiencies.

The axes **152*c*, 152*d***, along which the first and second check valves **154*a*, 154*b*** extend, are perpendicular and both extend at an angle of 45° to vertical. Covers **156*c*, 156*d*** cover access openings which lie in planes **158*c*, 158*d***, neither of which lies in a horizontal plane. Additional parts such as elbows **162*c*, 162*d*** are required for installation. The two shutoff valves **166*c*, 166*d*** and the two check valves **154*c*, 154*d*** are generally linearly arrayed. The means for connection **168*c*, 168*d*** of the inlet and outlet of the stop valves **166*c*, 166*d*** are vertically oriented. The check valves **154*c*, 154*d*** are of a type requiring that the flow through the valves be divergent **120*a*, 120*b*** around the edges of the valve disks.

Typically, a check valve is designed to maintain its open configuration as long as there is flow through the valve. Once the flow stops or drops below a predetermined value, the check valve closes. Typically, check

valves are designed so that, once the valve is closed, the inlet pressure must exceed a predetermined threshold before the valve will open. Usually, a single structure, typically a spring, is used both to provide the force to hold the valve closed (until the threshold is reached), and to provide the biasing force which moves the valve from the opened to the closed position. Because the biasing device provides some force tending to close the valve, even during normal flow conditions, a countervailing force must be provided to counteract the closing force and maintain the valve open, during normal flow conditions. Typically, the countervailing force is provided by the fluid moving through the valve. Accordingly, as the pressurized fluid moves through the valve, some amount of work is expended in holding the valve in the open position in opposition to the biasing force tending to close the valve. This expenditure of work causes a pressure drop across the check valve, so that the check valve itself necessarily creates a certain amount of loss of the pressure head. The amount of pressure minimally required at the inlet in order to maintain the valve in the open position is termed the "hold-open pressure." It is desirable to minimize the pressure drop or head loss during transit through the check valve, and, thus, it is desirable to reduce the hold-open force. Particularly, it is desirable that the hold-open force should be less than that from the threshold pressure.

Accordingly, a number of previous check valves having a biasing device have been produced, which create a greater force on the valve when it is in the closed position than when in the open position.

Many previous designs for reduced hold-open pressure check valves involve providing a linkage of one or more rigid pivoting arms connecting the clapper to the wall or body of the valve. U.S. Pat. No. 980,188, issued Jan. 3, 1911, to Blauvelt, for example, discloses a flap or swing-type valve having a clapper which can pivot toward or away from a valve seat. The clapper is pivotally connected to a rigid link or arm which, in turn, is pivotally connected to a spring.

Other valving devices include a knuckle or toggle-type linkage having two or more relatively pivoting arms or links.

SUMMARY OF THE INVENTION

The present invention includes the recognition of problems in previous devices, including those described above. It has been found that performance of backflow preventors is degraded when the number of changes in flow direction is increased. An increase in the number of changes in average streamline flow direction tends to increase pressure drop and degrade performance of a backflow preventor. As used herein, average streamlines can be considered to pass through the center of valve inlets, pass along a direction from an upstream valve outlet to a downstream valve inlet and pass along the centers of conduits elsewhere. Although the above-defined average streamline is used for purposes of explanation and analysis, it is recognized that actual flow will typically contain some amount of turbulence. Nevertheless, for purposes of explanation of the present invention, the defined and depicted streamlines approximate the general flow direction and are believed to approximate the actual streamlines averaged in space and time.

FIG. 7 depicts the average streamline **182** as dotted arrows. Tracing the flow from the upper flow in the inlet conduit **182** the downward flow in the outlet conduit **126**, there is a 90° change **184a** at the first elbow joint **162a**, a 45° change **184b** just prior to the inlet port of the first valve **154a**, 90° change **184c** between the inlet and outlet of the first valve **154a**, a 45° change **184d** downstream of the outlet of the first valve **154a**, a 45° change **184e** upstream of the inlet to the second valve **154b**, a 90° change **184f** between the inlet and the outlet of the second check valve **154b**, a 45° change **184g** downstream of the outlet from the second check valve **154b** and a 90° change **184h** at the second elbow **162b**. Thus, average streamline analysis shows that there is a total of 540° of change between the inlet conduit **124** and the outlet conduit **126**.

FIG. 8 shows the average streamline **182** for the configuration depicted therein. There is a 90° change **186a** at the first elbow joint **162c**, a 45° change **186b** prior to the inlet part of the first valve **154c**, a 90° change **186c** between the inlet and outlet of the first valve **154c**, a 90° change **186d** between the inlet and outlet of the second check valve **154d**, a 45° change **186e** downstream of the outlet from the second check valve **154d**, and a 90° change **186f** at the second elbow **162d**. Thus, average streamline analysis shows that there is a total of 450° of change between the inlet conduit **124** and the outlet conduit **126**.

A corresponding streamline analysis of the device shown in FIG. 6 indicates a total flow change of about 180°.

The present invention provides for increased performance without unacceptably degrading serviceability or installation factors. The present invention provides for a flow through open valves without requiring the flow to diverge around the edges of the valve disks. The valve components of the present invention, rather than inhibiting flow by requiring divergence as the flow moves through the valves, tends to enhance the desired flow by directing flow along the desired path. The present invention has an average streamline flow change of direction totalling about 180°. According to an embodiment of the present invention access to one of the check valves is in a vertical direction while access to the other is in a horizontal direction. The valves preferably extend along axes which are oriented at 90 to one another.

Valves containing a relatively large number of moving parts, such as pivoting rigid arms, are typically susceptible to wear or deterioration, particularly in corrosive, contaminated, or depositional environments, such as in hard water. Furthermore, rigid linkage systems are relatively expensive to design, produce, install, and maintain. Installation and maintenance often require use of special tools.

The present invention includes a spring which connects the valve clapper to the valve body. Preferably the spring connects the clapper to a removable cover portion of the valve body. The spring can be viewed as taking the place of one or more of the rigid links of previous devices. Preferably, the spring is directly connected to the clapper device, i.e., without an intervening linkage, and forms the sole connection between the clapper device and the valve wall (preferably the cover portion of the valve wall). The spring pivots with respect to the clapper about a pivot point, with the pivot point remaining in a fixed position with respect to both the end of the spring and the clapper device during opening and closing of the valve. The spring provides a force along its longitudinal axis without a lateral component.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a cross-sectional view through a check valving device showing a closed check valve and an opened check valve;

FIG. 1A is a partial cross-sectional view corresponding to FIG. 1, but showing another embodiment;

FIG. 2 is a cross-sectional view taken along line 2—2 of FIG. 1; and

FIGS. 3A and 3B depict, schematically, the triangles formed by the pivoting or attachment axes or points in the closed and opened configurations, respectively;

FIGS. 4A and 4B depict, schematically, an unstressed helical spring and a compressed and bowed helical spring;

FIGS. 5A and 5B depict, schematically, two end-joined helical springs, in unstressed and stressed configurations, respectively;

FIG. 6 is a schematic cross-sectional view of a backflow preventor according to a previous device;

FIG. 7 is a schematic cross-sectional view of an enclosed backflow preventor according to a previous device;

FIG. 8 is a schematic cross-sectional view of a backflow preventor according to a previous device;

FIG. 9 is a side elevational view, partly in cross-section of a backflow preventor according to one embodiment of the present invention;

FIG. 10 is a side-elevational view of a backflow preventor according to one embodiment of the present invention; and

FIG. 11 is a side-elevational view of a backflow preventor according to a second embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

A backflow preventor 212 according to one embodiment of the present invention is depicted in FIG. 9. The backflow preventor 212 includes first and second shutoff valves 214*a*, 214*b* and first and second check valves 12, 14. The shutoff valves can be any of a number of well-known valve designs, including a ball valve, a gate valve, or, preferably, a globe valve. Preferably, the shutoff valves can be manually opened or closed by moving external handles 269*a*, 296*b*. The valves 214*a*, 214*b*, 12, 14 are encased in a housing 216 which includes an inlet lower portion 218, a valve body 16, and an outlet lower portion 220. A conduit 222 leads from the first shutoff valve 214*a* to the inlet port 224 of the first check valve 12. The inlet port 224 is preferably circular in shape and surrounded by a valve seat 28. The inlet port 224 can be closed by the clapper or valve disk 32. The valve disk 32 is movable between a closed configuration or position (FIG. 1) and an open configuration as depicted in FIG. 9. The flow exits the first valve region 12 through an outlet port 226 and enters a conduit 228 which provides fluid communication between the first check valve 12 and the second check valve 14. In the embodiment depicted in FIG. 9, the conduit 228 contains a first downward sloping portion 232 imparting a shape to the apparatus similar to the letter "N". At the downstream end of the conduit 228 is an inlet port 234 of the second check valve 14. Surrounding the inlet port 234 is a valve seat 76. The second check valve 14 operates in a manner substantially similar to that of the first check valve 12 as described more fully below. Flow leaves the second check valve 14 to an outlet port 236 and is conveyed by a conduit 238 to a second shutoff valve 214*b*.

As seen in FIG. 9, the first and second check valves 12, 14 are positioned generally vertically above the inlet and outlet stop valves 218, 220 and the second check valve and shutoff valve 14, 214*b* are substantially level, but horizontally displaced from the first check valve and shutoff valve 12, 214*a*. Thus, the flow from the first shutoff valve 214*a* to the first check valve 12, the second check valve 12 and the second shutoff valve 214*b* is in a generally inverted-U shaped, as opposed to a linear shape such as that depicted in FIGS. 7 and 8. In this way, the horizontal extent 262 of the backflow preventor 212 is reduced, compared to linear configurations such as those in FIGS. 7 and 8. As can be seen from FIG. 9, the horizontal extent 262 of the backflow preventor 212 is also reduced, compared to a configuration such as that depicted in FIG. 6, since the handles 264*a*, 264*b* by which the shutoff valves 214*a*, 214*b* are operated, extend in a direction perpendicular to a line connecting the inlet and outlet conduits 124, 126. The direction in which the handles 264*a*, 264*b* move as the shutoff valves 214*a*, 214*b* are opened and closed, is a direction perpendicular to a line connecting the conduits 124, 126. By providing shutoff valve handles 264*a*, 264*b* which extend and move in a direction perpendicular to the line connecting the conduits 124, 126, the horizontal extent of the backflow preventor 212, in a direction along the line connecting the conduits 124, 126 is reduced, compared to devices such as that depicted in FIG. 6.

The first check valve 12 extends generally along an axis 242. The second check valve 14 extends along an axis 244. In the embodiment depicted in FIG. 9, the second check valve extends along an axis 244 which is at approximately 90° to the axis 242 of the first check valve 12.

An opening 246 is provided in the housing 216 in the region of the first check valve 12, covered by a covering 248. The covering 248 (FIG. 10) is removably held in place by bolts 252*a*, 252*b*. When access to the first check valve 12 is desired, such as for maintenance or installation, the bolts 258*a*, 258*b* are removed and the covering 248 is removed to expose the first check valve 12 through the opening 246. As can be seen from FIG. 9, access to the first check valve 12 is along a vertical direction.

A second opening 254 is provided in the housing 216 in the region of the second check valve 14. The opening 254 is covered by a covering 256 removably held in place by bolts 258*a*, 258*b*. When access to the second check valve 14 is desired, the covering 256 is removed. As can be seen from FIG. 9, access to the second check valve 214 is in a horizontal direction.

The lower portion of the backflow preventor 212 includes flanges 266*a*, 266*b* for connection to the inlet and outlet conduits 124, 126. Because the flanges 266*a*, 266*b* are horizontally oriented, the backflow preventor 212 can be positioned to rest on the inlet and outlet conduits 124, 126 during installation, thus avoiding the need for supports such as those 172*a*, 172*b* depicted in FIG. 7.

During operation, fluid enters the first shutoff valve 214*a* from the inlet conduit 124 in a first flow direction 268. The average streamline flow 272*a* continues through the conduit 222 and through the inlet port 224 without substantial change in direction until it reaches the valve disk or clapper 32. As shown in FIG. 9, be-

cause of the configuration of the valve disk 32 flows through the inlet port 224 is substantially straight 276 and non-divergent. When the flow reaches the clapper 32 (i.e., when any fluid "parcel" component of the flow reaches the clapper 32) there is a 90° change of direction 274. When the clapper 32 is in the open configuration, as depicted in FIG. 9, it is positioned so as to direct the flow (as analyzed by the position of the average streamline) from the first direction 272*a* (i.e., substantially vertically upward) to a second direction, 272*b* (i.e., substantially horizontally toward the second check valve 13). In the embodiment depicted in FIG. 9, the clapper 32 acts as a flow director because it forms a surface positioned substantially at an angle with respect to the upward flow 272*a*.

The flow 272*b* which has been redirected by the clapper 32 exits the outlet port 226 and flows through the conduit 228 towards the second check valve 14. The flow 272*b* passes through the inlet port 234 of the second check valve 14. During such passage, the flow is substantially straight and non-divergent 278. The flow 272*b* proceeds from the first check valve 12 to the second check valve 14 substantially without change of direction until it reaches the clapper 72 of the second check valve 14. The clapper 72 acts as a flow director, in a manner similar to that of the first clapper 32, redirecting the flow 272*b* to a vertically downward direction to 272*c*. Thus, there is a second 90° change in flow direction 282 of the average streamline 272. As can be seen from FIG. 9, the total change in direction of the average streamline 272 is the sum of the two changes of direction 274, 282, both of which are approximately 90°, providing a total of about 180° of change in direction.

FIG. 11 depicts a backflow preventor 286 according to a second embodiment of the invention. The backflow preventor 286 depicted in FIG. 11 is substantially similar to the backflow preventor depicted in FIG. 10 except for the addition of a relief valve 288 and a conduit 292. The relief valve 288 is provided in order to discharge possibly contaminated water into the atmosphere to prevent its entering the water source. A number of relief valves of types well-known in the art can be used. The relief valve 288 and conduit 292 are connected to the housing 216 in two places. The conduit 292 connects the relief valve 288 to a portion of the housing 293 which is upstream of the first check valve 12. The relief valve 288 is also connected to a region 296 (FIG. 9) which is downstream of the first check valve 12. For proper operation, the region 296 should be a distance 298 below the level 299 of the inlet port 224 for the first check valve 12. This change in level 298 is provided by the downward sloping portion 232. In operation, when pressure at the upstream location 293 falls below a predetermined level with respect to pressure in the valve interior, the valve 288 opens to permit discharge of water.

Test cocks 297*a*, 297*b*, 297*c* are connected to the housing 216 in order to provide a position for pressure testing, e.g., by connecting a differential pressure gauge.

As depicted in FIG. 1, a check valving device 10 is provided having a first check valve 12 and a second check valve 14. Although FIG. 1 depicts the first check valve 12 in a closed position, and the second check valve 14 in an open position, in actual operation, as described more fully below, the first and second valves 12, 14 will open and close substantially simultaneously or within a short time interval of one another. The valving device includes a valve body 16 made up of a wall 18. The valve body 16 can be formed of a number of materials, including ductile iron, brass, stainless, steel, or other metals, plastic, resin, glass, and/or ceramic and the like. The valve body 16 defines an inlet port 22 and an outlet port 24, preferably having a substantially circular cross-section. Preferably, the inlet port and outlet port include devices, such as flanges 26, for connecting the valving device 10 to fluid conduits. Adjacent to the inlet port 22 is a valve seat 28, such as an annular seat formed, for example, of iron.

A disk-shaped clapper 32 is rigidly connected, such as by using a bolt 34 and nut 36, to a clapper arm 38. A first end 39 of the arm 38 is pivotally mounted adjacent the valve seat 28 by connection to a portion of the valve body 16 by a pivot joint 42*a*, 42*b* to permit pivoting of the arm 38, and rigidly attached to disk 32 about a first axis 43.

The lower surface of the clapper 32 includes a seat disk 44 configured to sealingly mate with the valve seat 28 when the clapper 32 is pivoted to its closed position, as depicted in the left portion of FIG. 1. The disk 44 can be made of a number of materials, including plastic, rubber, resin, and the like, and is preferably a soft (such as about 40 urometer) elastomer material, such as a synthetic rubber e.g., EPDM (ethylene-propylene terpolymer). The disk 44 is reversible so that after it experiences wear, it can be removed, rotated 180° about a horizontal plane, and reinstalled.

The second end 48 of the clapper arm 38 is pivotally connected to a spring 52. The spring 52 is contained between first and second spring seats 54, 56. The spring 52 is preferably a helical spring which is compressional, i.e., is reduced in length as the valve 12 opens. The spring 52 can be formed of a number of materials, such as spring steel, plastic, or rubber. A single helical spring 52', such as that depicted in FIG. 4A, is commonly subject to deformation when compressed. As shown in FIG. 4B, a compressed helical spring commonly assumes a bowed or arcuate configuration. Although such a spring can be used in accordance with the present invention, according to the preferred embodiment, two springs 52A, 52B are joined end-to-end by connection to a plate-like or annular device, such as a washer 53, as depicted in FIG. 5A. Upon compression, as depicted in FIG. 5B, such a spring 52 tends to maintain its linear configuration and is not subject to bowing or distortion to the degree an ordinary helical spring 52B is.

The first spring seat 54 is pivotally attached to the second end 48 of the clapper arm 38 to permit pivoting of the spring 52 about a second axis 64.

The second spring seat 56 is pivotally connected to the valve body wall 18. In the preferred embodiment, the portion of the valve wall which the second spring seat 56 connects to is a removable cover 65 which can be attached to the remainder of the valve body wall 18, by e.g., bolts, screws, clamps, or the like (not shown). As shown in FIG. 1, the second spring seat 56 can be connected within a pocket 58 at an attachment point 62, to permit pivotal movement of the spring 52 about a third axis 66.

In the embodiment depicted in FIG. 1, the second valve 14 is positioned downstream from the first valve 12. Preferably, the second valve 14 is identical in construction to the first valve 12, and includes a clapper 72, a biasing device, such as a spring 74, and a valve seat 76. It will be understood, however, that the present invention can be used in single check valve configurations or other types of valve configurations.

Viewed in cross-section, each of the two valves 12, 14 define a triangle having vertices at the first axis 43, 43', second axis 64, 64', and third axis 66, 66', respectfully. When the valve 12 is closed, the spring biasing device 52 provides a force to the clapper 32, tending to hold the clapper 32 in the closed position. The amount of force is dependent upon two factors: (1) the magnitude of the longitudinal force provided by the spring 52; and (2) the component of that force which acts in a direction tending to close the clapper 32. As depicted in FIGS. 3A and 3B, the spring closing force can be described as

$$\mathrm{Sin}(180^\circ - \alpha).\bar{F} \qquad (1)$$

where α 77, 77' is the angle formed between the lines containing the first and second axes 43, 64, and the line containing the second and third axes 64, 66, and $\bar{F}$ 79, 79' is the vector force provided by the spring along the longitudinal spring axis which intersects the second axis 64 and third axis 66.

When the inlet pressure exceeds the outlet pressure, an opening force is created. When the opening force on the clapper 32 exceeds the spring closing force (shown in equation (1) plus any closing forces provided by other sources, such as fluid pressure the clapper 32 moves away from the valve seat 28, opening the valve 12 to provide fluid communication between the inlet port and the outlet port 24. During the opening movement of the valve 12, the position of the second axis 64 changes with respect to the valve body 10, but does not change with respect to the clapper 32 or with respect to the adjacent end of the spring 52.

As the clapper 32 pivots about the first axis 43, the angle α increases from a value of about 118° 77 in the configuration shown on the left-hand portion of FIG. 1 (depicted schematically in FIG. 3A) to a value of about 164° 77' when in the fully opened configuration of the valve 14, shown on the right-hand portion of FIG. 1 (depicted schematically in FIG. 3B). The magnitude of the closing force provided to the clapper 32 thus changes from about 87% of that of the spring force $\bar{F}$ 79 to about 27% of that of the spring force $\bar{F}$ 79'. However, during this time, the magnitude of spring force $\bar{F}$ also changes, since it is proportional to the length of the spring 52, becoming larger as the valve 12 opens. In order to produce a valve 12 having a reduced hold-open force, the extreme values of the angle α 77, 77', the distance between the first and third axes 43, 66, and first and second axes 43, 64 are selected so that equation (1) yields a smaller closing force in the opened position of the valve (FIG. 3B) than in the closed position of the valve (FIG. 3A).

The particular values for the hold-open force, maximum tolerable head loss, and the threshold opening pressure will depend upon the particular use or application of the valving device 10. In one embodiment of the present invention, valving device 10 opens when the inlet pressure exceeds the outlet pressure by about 2-5 psi (about 14-35 kPa), and closes when the outlet pressure equals or exceeds the inlet pressure. Preferably, this embodiment has a head loss of less than 2 psi in a static or no-flow (limiting) condition, and there is little increase in head loss as the flow increases, such as a head loss of about 3 psi (about 20 kPa), with an operational flow velocity of about 7.5 ft./sec. (about 2.3 meters/sec.), or a rated flow velocity, e.g., 18 ft./sec. (about 5.5 meters/sec.) In another embodiment, the static condition head loss is about 8 psi (about 56 kPa), and the head loss during flow conditions remains below about 10 psi (about 70 kPa).

Based on the above description, a number of advantages of the present invention are apparent. The backflow preventor in the present invention has enhanced performance, such as lower pressure drop, has a decreased number of changes of flow direction and reduces or eliminates divergent flow around the edges of valve disks. The present invention provides for ease of installation by reducing the number of parts needed, reducing the size of the square footage needed for an enclosure or pit, and by eliminating the need for supports during installation. The present invention produces these benefits without substantial degradation of serviceability by providing for vertical access to at least one check valve with horizontal access to the other check valve. By providing a device in which the valves are aligned 90° to each other and in which the total change of direction is about 180°, a backflow preventor is provided which has enhanced performance without substantial degradation of serviceability. The valve of the present invention reduces or eliminates rigid pivoting links. By reducing or eliminating links, the valve is made easier to design, produce, install, and maintain, and, in the preferred embodiment, can be installed and maintained without the use of special tools. The valve provides sufficient closing force and hold-closed force, while having a hold-open force which is low enough to produce a small head loss.

A number of modifications and variations of the invention can be used. The backflow preventor described above, in particular the housing and flow configuration, can be used in conjunction with check valves other than the check valves described, such as flapper valves with other types of biasing mechanisms. A single check valve of the type described can be used without being provided in conjunction with a second such check valve. The valve can be used for purposes other than as a backflow preventor. The check valve of the present invention can be used in combination with other valves or fluid-control devices. The valve can be used with fluids other than liquids. The valve can be configured without using a clapper arm, such as by directly pivoting the spring to the clapper and/or directly pivoting the clapper adjacent the valve seat. Other shapes and geometries of the clapper, ports, valve seats, and other components can be used. Other types of biasing devices can be used, including springs other than helical springs, hydraulic biasing devices, and the like.

Although the description of the invention has included a description of a preferred embodiment and certain modifications and variations, other modifications and variations can also be used, within the scope of the invention, which are described by the following claims.

What is claimed is:

1. A backflow preventor apparatus for connection to parallel, oppositely-flowing inlet and outlet conduits, comprising:

- a housing configured to accommodate first and second valves, and to receive fluid flow from said inlet conduit flowing in a first direction;
- a first valve mounted in said housing having a first clapper movable between an open configuration permitting flow through said first valve and a closed configuration preventing flow;
- a second valve mounted in said housing having a clapper movable between an open configuration

permitting flow through said second valve and a closed configuration preventing flow;

said first valve clapper, when in said open configuration, being positioned to direct said flow from said first direction to provide flow in a second direction, different from said first direction, towards said second valve;

said second valve clapper, when in said open configuration, being positioned to direct said flow from said second direction to a third direction, different from said second direction towards said outlet conduit.

2. Apparatus, as claimed in claim 1, further comprising:

at least a first shutoff valve connected to said housing, operable by a handle extending substantially horizontally outward from said housing in a direction substantially perpendicular to a line passing through said inlet and outlet conduits.

3. Apparatus, as claimed in claim 1, further comprising:

at least a first shutoff valve connected to said housing, operable by a handle which, during opening and closing of said shutoff valve, moves substantially horizontally outward from said housing in a direction substantially perpendicular to a line passing through said inlet and outlet conduits.

4. Apparatus, as claimed in claim 2, further comprising:

a second shutoff valve positioned between said housing and one of said inlet and outlet conduits.

5. Apparatus, as claimed in claim 1, wherein said housing includes a valve body having at least first and second ports, one of said ports being an inlet port and the other of said ports being an outlet port, and wherein at least one of said first and second valves includes

a valve seat adjacent to said first port;

a clapper configured to sealingly mate with said valve seat, said clapper pivotally attached adjacent to said valve seat to pivot about a first axis between a first position, wherein said clapper sealingly mates with said valve seat and at least a second position spaced from said valve seat;

first means for biasing said clapper in a direction toward said first position, said means for biasing having a first end and a second end, and forming a compressible connection between said clapper in said first position and said valve body;

second means, adjacent said first end, for attaching said means for biasing to said valve body at an attachment point; and

third means, adjacent said second end, for pivotally attaching said means for biasing to said clapper to permit pivoting of said means for biasing with respect to said clapper about a second axis, wherein the position of said second axis, with respect to said clapper and with respect to said second end, remains fixed during movement of said clapper from said first position to second position.

6. Apparatus, as claimed in claim 1, wherein said housing includes a valve body having at least an inlet port and an outlet port, and wherein at least one of said first and second valves includes:

an annular valve seat adjacent to said inlet port;

a disk-shaped clapper configured to sealingly mate with said annular valve seat;

an arm rigidly attached to said clapper having a first end and a second end, said first end being pivotally attached adjacent to said inlet port to permit pivoting of said clapper about a first axis from a first position sealingly mating with said valve seat to a second position spaced from said valve seat to permit fluid flow through said inlet port; and

a helical compression spring having first and second spring ends, said first spring end pivotally attached to said valve body to permit pivoting of said spring about a second axis, said second spring end directly pivotally attached to said second end of said arm, to permit pivoting of said spring with respect to a third axis said spring producing a force along a first longitudinal spring axis definable with respect to said first spring end and said second spring end, said force having a closing component which biases said clapper to move in a direction toward said first position, said force being direct along a line passing through said second axis and said third axis substantially without a lateral force component in any clapper position, said closing component being greater when said clapper is in said first position than when said clapper is in said second position.

7. Apparatus, as claimed in claim 1, wherein said first valve, when in said closed configuration, is adjacent a valve seat, said valve seat positioned at a first level, and wherein said housing includes:

a conduit connecting said first and second valves, said conduit having at least a first portion sloping downward to provide a region at a level below the level of said valve seat of said first valve.

8. Apparatus, as claimed in claim 1, further comprising a relief valve connected to said housing by at least a first conduit, said first conduit providing fluid communication with a first region of said housing upstream of said first valve and connected to said housing to provide fluid communication with a second region of said housing downstream of said first valve.

9. A backflow preventor apparatus for connection to parallel, oppositely-flowing inlet and outlet conduits, comprising:

a housing configured to accommodate first and second valves, and to receive fluid flow from said inlet conduit flowing in a first direction;

a first valve mounted in said housing having a first clapper movable between an open configuration permitting flow through said first valve and a closed configuration preventing flow;

a second valve mounted in said housing having a clapper movable between an open configuration permitting flow through said second valve and a closed configuration preventing flow;

said first valve clapper, when in said open configuration, being positioned to direct said flow from said first direction to provide flow in a second direction towards said second valve;

said second valve clapper, when in said open configuration, being positioned to direct said flow from said second direction to a third direction towards said outlet conduit;

first and second openings in said housing, said first opening providing access to said first valve and said second opening providing access to said second valve, one of said first and second openings lying in a substantially horizontal plane, the other of said openings lying in a substantially vertical plane; and

first and second removable coverings for said openings.

10. A backflow preventor apparatus for connection to parallel, oppositely-flowing inlet and outlet conduits, comprising:

a housing configured to accommodate first and second valves, and to receive fluid flow from said inlet conduit flowing in a first direction;

a first valve mounted in said housing having a seatable valve disc having an edge, movable between a closed configuration preventing flow and an open configuration permitting flow in the absence of substantial divergent flow around the edge of said first valve disc, said first valve lying substantially in a first plane when said first valve is in said open configuration;

a second valve mounted in said housing having a seatable valve disc having an edge, movable between a closed configuration preventing flow and an open configuration permitting flow in the absence of substantial diverging flow around the edge of said second valve disc, said second valve lying in a plane substantially perpendicular to said first plane when said second valve is in said open configuration;

said fluid flow having an average streamline path between said inlet conduit and said outlet conduit.

11. Apparatus, as claimed in claim 10, wherein the sum of changes in flow direction of said average streamline path is not substantially greater than about 180 degrees.

12. A backflow preventor apparatus for connection to parallel, oppositely-flowing inlet and outlet conduits, comprising:

a housing configured to accommodate first and second valves, and to receive fluid flow from said inlet conduit flowing in a first direction;

a first valve mounted in said housing having a seatable valve disc having an edge, movable between a closed configuration preventing flow and an open configuration permitting flow in the absence of substantial divergent flow around the edge of said first valve disc;

a second valve mounted in said housing having a seatable valve disc having an edge, movable between a closed configuration preventing flow and an open configuration permitting flow in the absence of substantial diverging flow around the edge of said second valve disc;

said fluid flow having an average streamline path between said inlet conduit and said outlet conduit wherein the sum of changes in flow direction of said average streamline path is not substantially greater than about 180 degrees;

said first valve disc, when in said open configuration, being positioned to direct said flow from said first direction to provide flow in a second direction, different from said first direction, towards said second valve;

said second valve disc, when in said open configuration, being positioned to direct said flow from said second direction to a third direction, different from said second direction, towards said outlet conduit.

13. A backflow preventor apparatus for connection to parallel, oppositely-flowing inlet and outlet conduits, comprising:

a housing configured to accommodate first and second valves, and to receive fluid flow from said inlet conduit;

a first valve mounted in said housing having a seatable valve disc having an edge, movable between a closed configuration preventing flow and an open configuration permitting flow through a first inlet port in a first direction, said first valve mounted to extend along an axis defined by said first direction;

a second valve mounted in said housing having a seatable valve disc having an edge, movable between a closed configuration preventing flow and an open configuration permitting flow through a second inlet port in a second direction, said second valve mounted to extend along an axis defined by said second direction, said axis of mounting of said second valve being substantially perpendicular to said axis of mounting of said first valve;

said fluid flow having an average streamline path between said inlet conduit and said outlet conduit, wherein the sum of changes in flow direction of said average streamline path is not substantially greater than about 180 degrees.

14. A method for preventing backflow between parallel, oppositely-flowing inlet and outlet conduits, comprising:

providing a housing configured to accommodate first and second valves, and to receive fluid flow from said inlet conduit flowing in a first direction;

mounting a first valve in said housing, said first valve having a first clapper movable between an open configuration permitting flow through said first valve and a closed configuration preventing flow;

mounting a second valve in said housing, said second valve having a clapper movable between an open configuration permitting flow through said second valve and a closed configuration preventing flow;

attaching said housing to said inlet and outlet conduits;

directing said flow from said first direction to provide flow in a second direction, different from said first direction, towards said second valve, using said first valve clapper, when in said open configuration; and

directing said flow from said second direction to a third direction, different from said second direction, towards said outlet conduit, using said second valve clapper, when in said open configuration.

* * * * *

No. 3695/31.

APPLICATION DATED

25th August, 1931.

Applicant (Actual Inventor) ... ... LEWIS ERNEST SAUNDERS.
Application and Provisional Specification Accepted 25th September, 1931.
Complete Specification ... Accepted 25th August, 1932.
Acceptance Advertised (Sec. 50) ... 1st September, 1932.

Classes 37.1 ; 74.5.

Drawing attached.

COMPLETE SPECIFICATION.

"Automatic watering systems for poultry and other live stock."

I, LEWIS ERNEST SAUNDERS, of 113 Gouger Street, Adelaide, South Australia, Engineer, hereby declare this invention, and the manner in which it is to be performed, to be fully described and ascertained in and by the following statement:—

In my Patent 26,365/25 I describe a float and valve suitable for feeding water from a tank at a higher level into one at a somewhat lower level and this device can be enlarged on and used with the present invention.

In poultry farms, the water supply is required to be delivered at several points and it is an advantage if this can be done automatically.

By putting in a tank, which can be kept supplied with water from the mains by such means as a ball cock device, at some higher level than the highest point at which the water is required on the poultry farm, and feeding from this tank by means of pipes laid in any convenient position to wherever the water is required, a float and valve of the type described in my Patent 26,365/25 can be successfully used to automatically supply any shape or size of vessel required with a constant level of water and as there will only be a low pressure of water in the pipes, if the valve is made so as to be connected to the pipe by means of a swivel joint, when it is required to shut off the water at any valve, the mere act of turning the valve so that the float is uppermost will do so as the weight of the float will then keep the valve shut, and the drinking vessel can be cleaned out or left empty as required.

It is also often necessary to make arrangement for the level of the drinking vessel to be at different heights so that it can be right on the ground for young chickens and perhaps a foot above the ground for full grown fowls, or any height in between as desired, and I therefore arrange that the pipe on to which the valve is swivelled shall be say, a foot in length and shall be made in the shape of an S or other appropriate form and act also as a swivel joint at the point where it is screwed into the fitting on the main pipe, being locked into this fitting in any position by means of a backnut.

The whole device then becomes universal for supplying water to any sized vessel at the required height.

Of course the valve described in Patent 26,365/25 is not the only type that can be used to advantage with the S shaped pipe made into what could be called a double swivel, even valves that can not be turned up to shut them off, can with advantage be

C.9466.—15/9/32.—100.—Price, 1s. 6d. post free.

used with such device so as to raise and lower them in comparison with ground level and so make the height suitable for both small and large birds.

In the drawings:

Fig. 1 is an elevation showing an S pipe and float and valve as in my Patent 26,365/25 but made with the addition of a swivel.

Fig. 2 is a general view of a tank, water pipe leading from same and two fittings showing the S pipe in different positions.

A is the tee, elbow or swivel fitting on the main pipe; B is the S shaped pipe; C, swivel joint to vary height of water vessel above ground level; D, lock nut or similar device to hold S pipe in any position desired; E, swivel valve in open position; F, swivel valve in closed position; G, leather or other washer to make swivel tight against end of pipe C; H, nut of swivel joint; I, lock nut to hold nut of swivel joint firm; J, spindle of valve; L, float; M, water vessel.

Referring to the drawings, A is the end view of a fitting on a pipe line preferably laid along the ground, and connected to a tank or cistern as shown in Fig. 2 through which water can be passed into an S or U shaped pipe B such pipe being screwed into fitting A as shown at C and locked there by means of backnut D when the other end of pipe B on to which the swivel joint H and backnut I are fixed is any desired height above ground level.

Because the valve E is swivelled as at H such valve can be made to stand in a vertical position no matter at what angle as compared with ground level the pipe B is locked into A as shown in two positions in Fig. 2.

The valve E spindle J and float K are of approximately the same design as that shown in my Patent Specification 26,365/25, these being used in combination with the flange on the valve casting as shown just behind the leather washer G Fig. 1, such leather or other washer, the loose nut H to hold these two parts against the end of pipe B whilst still leaving the valve free to swivel, and the locknut I provided to keep H from moving by the friction of such swivelling.

This combination makes it possible to turn the valve upside down as shown at F Fig. 1 and use the weight of the float to keep the valve closed. The dish or other vessel can thus be left empty or taken away for cleaning as desired the turning down of the valve again being all that is necessary to supply water to the vessel.

In actual use it is found convenient to turn up this valve and so cut off the water fairly frequently and if this were done by rotating the valve in an anti clockwise direction it would tend to loosen the nut H and the purpose of locknut I is to overcome this movement of nut H.

Having now fully described and ascertained my said invention and the manner in which it is to be performed, I declare that what I claim is:—

1. In automatic watering systems for poultry and other live stock means such as an S pipe swivelled or screwed at one end into a fitting on the main pipe and locked on to same in any position by means of a back nut or similar device, with a swivel jointed valve at the other end of such S pipe, the nut of such swivel being locked in position by a back nut or similar device to keep it from loosening or tightening when the swivel valve is turned, so that such valve can be set at varying levels above the ground as desired.

2. In automatic watering systems for poultry and other live stock a valve operated by a float as shown in the drawings and described in Commonwealth Specification 26,365/25, such valve being swivelled to the water pipe to which it is connected and therefore being capable of standing either in a position with the float down below the valve or with the float up above the valve.

3. In automatic watering systems as claimed in Claim 2 the device of a valve of the type described in Commonwealth Specification 26,365/25, capable of being shut off by the buoyancy of the float when this is below the valve and is raised by the water in a vessel and of being shut off by the weight of the same float when the valve is turned so that the float is above this valve.

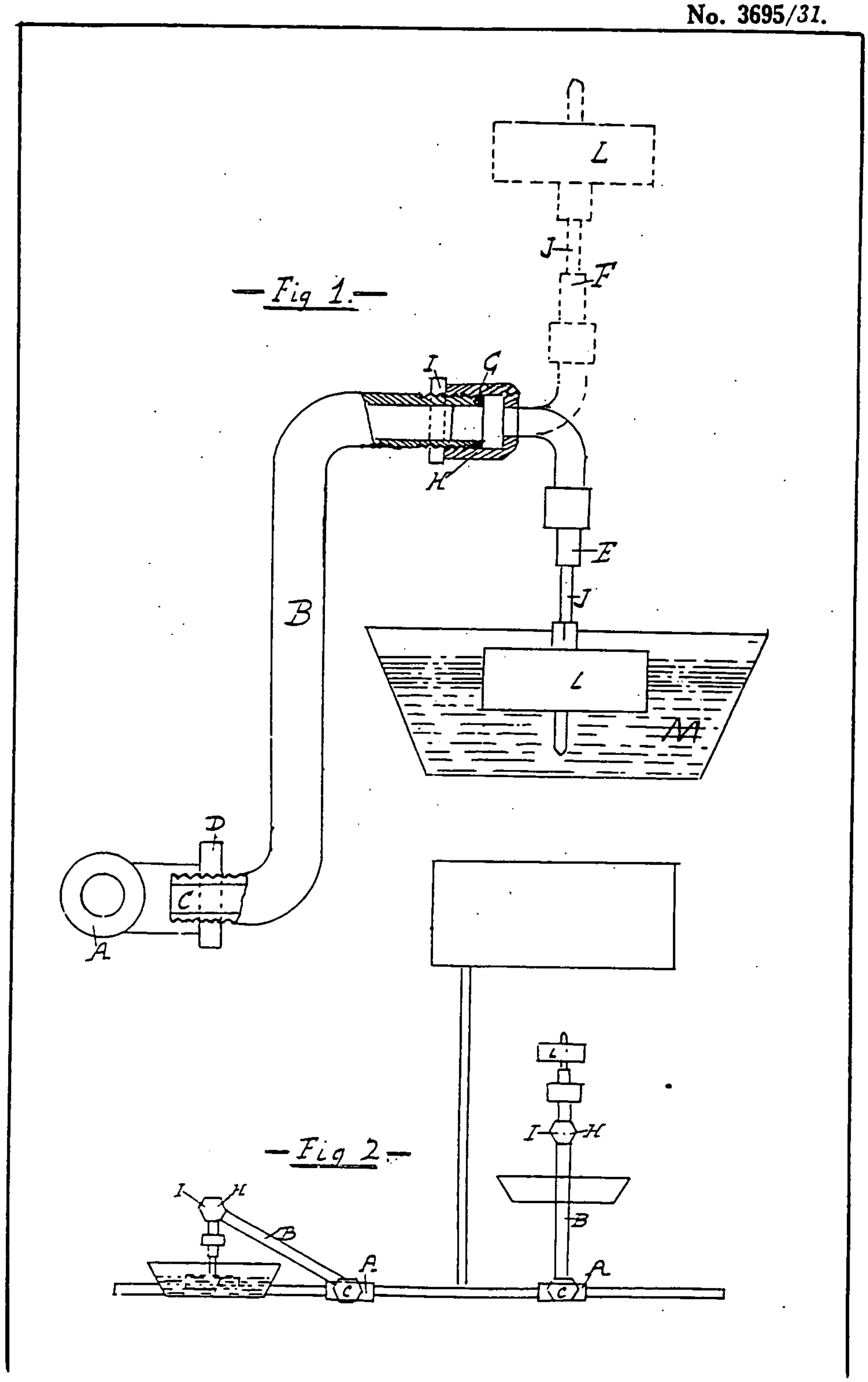
Dated this 24th day of May, A.D. 1932.

LEWIS ERNEST SAUNDERS.

Witness—Sarah Eugenie Saunders.

Printed and Published for the DEPARTMENT OF PATENTS, COMMONWEALTH OF AUSTRALIA, by H. J. GREEN, Government Printer for the State of Victoria.

No. 3695/31.



223587

COMMONWEALTH OF AUSTRALIA

PATENT SPECIFICATION 25,735/57.

Complete Specification Lodged .... 10th February, 1958.
Application Lodged (No. 25,735/57) .... 28th February, 1957.

Applicant........................B. A. Hamill Proprietary Limited.

Actual Inventor...................Arthur Francis Oldfield.

Complete Specification Published .... 14th August, 1958.
Complete Specification Accepted .... 21st August, 1959.

Classification 74.5.

Drawing attached.

COMPLETE SPECIFICATION.

"IMPROVEMENTS RELATING TO FLUID TIGHT SWIVEL COUPLINGS."

The following statement is a full description of this invention, including the best method of performing it known to us:-

This invention relates to fluid tight or sealed swivel couplings of the type in which one or both pipes or tubes coupled by the coupling are free to relatively rotate or angularly move without any escape of the fluid. Such couplings are widely used in compressed air, pressure liquid and steam lines, particularly steam lines for tyre moulds and the like.

It is the principal objective of the instant invention to provide an improved coupling of the type specified having the characteristic of simplicity in construction with consequent economy in production without sacrificing the essential requirement of maintaining a positive fluid leak-proof seal between the movable component parts of the coupling.

With the above stated objective in view there is provided according to the invention a swivel coupling comprising an intermediate tubular body section, a relatively fixed pipe connecting section having a cylindrical stem threaded into one end of the body section, a relatively rotatable pipe connecting section having a coaxial plain cylindrical stem projecting into the other end of the body section to neatly fit the bore of the threaded cylindrical stem, an annular sealing means disposed about the plain cylindrical stem between the end of the threaded cylindrical stem and a seating

in the bore of the body section, and means retaining the rotatable pipe connecting section in assembly with said body and fixed sections including at least one pin projecting through the body portion or section and an aligning peripheral annular groove in the cylindrical extension or stem of the relatively rotatable pipe connecting section, to restrain axial movement without obstructing relative rotation a movement of said rotatable section.

Conveniently the construction and disposition of the above retaining means is such that the above relatively rotatable pipe connecting section can be readily removed to permit maintenance operations to be carried out such as the replacement of the sealing means or members which are preferably composed of resilient or flexible material impervious to the particular fluid or liquid.

The accompanying drawings depict a practical arrangement of a swivel pipe coupling according to this invention.

In these drawings:-

Fig. 1 is an elevation partly in section of the coupling.

Fig. 2 is a vertical central "exploded" section of the coupling.

Fig. 3 is a section taken on line 3-3 of Fig. 1.

Fig. 4 is a section taken on line 4-4 of Fig. 1.

Referring now to the drawings viewed in Figs. 1 and 2 the coupling illustrated comprises a casing or housing indicated generally at 5 and having a rotatable male section 6, a body section 7, and a relatively fixed female section 8, the male and the latter section 6 and 7 each being formed with terminal nut portion 9 and internal threaded bores 10 for attachment to one of the pipes 11 and 12 to be coupled.

The male section 6 is curved at the inner end 6a, terminating in a straight stem 13 formed at the outer end with a pair of closely spaced parallel collars 14 and 15 forming therebetween an annular groove 16.

The hexagonal body section 7 has a stepped axial bore 17, one end 17a of which is large enough for insertion of the above-mentioned collars 14 and 15, and the straight stem 13 of the male section 8, the collar 15 seating against the angular shoulder 17b defining the end section 17a of the bore 17. The coaxial stem 13 of the male section 8 projects into the bore of the female section 8 indicated generally at 20 which is fitted into the other end of the bore 17 of the body section 7 as viewed in Fig. 3.

The female section 8 is also formed with a similar arcuate end 8a and a straight stem portion 22 which has a shoulder 22a at the outer end, and a stepped threaded section 23 to thread into a threaded portion 17c in the opposite end of the bore 17 of the body section 7, a lock nut 24 being provided to retain the female section 8 in the assembled position

with the body section 7 as viewed in Fig. 3. The bore 20 of the female section 8 is enlarged as at 25 in the straight stem 22 presenting an annular shoulder 25a. The straight stem 13 of the male section has a neat fit in the enlarged section 25 of the bore of the female section 8 such that the end thereof is closely spaced to the annular shoulder 25a as viewed in Fig. 3 when passed in assembly through the body section 7.

The enlarged end 25 of the bore 20 of female stem 22 has about the inner face a conical or like seating 26 for an annular sealing ring or member 27 which is arranged upon the straight stem 13 of the male section 6 to engage with the seating 26. The sealing ring or member 27 may consist of a pair of complementary washers of suitable material.

Similarly there is a conical apertured sealing face 28 in the bore 17 of body section 7 through which the male section stem 13 projects, and the above sealing ring or member 27 is seated thereon and clamped between the sealing faces 26 and 28 whereby the rotatable portion of the said stem 13 located in the stem 22 of female section 8 is completely sealed off within the body section 7 to prevent the escape of the fluid.

The body section 7 has a pair of aligning spaced apertures 28 and 29 disposed one each side of its axis and opening in the bore 17 so as to lie in assembly in radial alignment with the above-mentioned annular groove 16 between the collars 14 and 15 in the male section 6. As illustrated in Figs. 3 and 4 a pair of pins 31 are inserted through the apertures 28 and 29 to seat in the above annular groove 16 so as to restrain the male section 6 from axial movement without obstructing rotation thereof relative to the female section 8.

The pins 28-29 traverse the annular groove as the male section 6 rotates, or the body and female rotate relative to the male section.

The claims defining the invention are as follows:-

1. A swivel coupling of the type herein specified comprising an intermediate tubular body section, a relatively fixed pipe connecting section having a cylindrical stem threaded into one end of the body section, a relatively rotatable pipe connecting section having a coaxial plain cylindrical stem projecting into the other end of the body section to neatly fit the bore of the threaded cylindrical stem, an annular sealing means disposed about the plain cylindrical stem between the end of the threaded cylindrical stem and a seating in the bore of the body section, and means retaining the rotatable pipe connecting section in assembly with said body and fixed sections including at least one pin projecting through the body portion or section and an aligning peripheral annular groove in the cylindrical extension or stem of the relatively rotatable pipe connecting section, to restrain axial movement without obstructing relative rotation movement of

said rotatable section. (26th February, 1957).

2. A swivel coupling according to claim 1 wherein the construction and arrangement or disposition of the retaining means is such that the relatively fixed pipe connecting section is removable. (26th February, 1957).

3. A swivel coupling according to any one of the preceding claims wherein the body portion or section is formed with a stepped bore having an intermediate reduced annular shoulder defining upon one side a seating for a collar upon the extension or stem of said rotatable portion or section, and upon the other side a seating for the sealing means retained between the latter seating and a seating upon the inner end of the threaded stem of the relatively fixed pipe connecting section. (26th February, 1957).

4. A swivel coupling according to claim 1, 2 or 3 wherein the peripheral groove in the plain stem of said rotatable section is defined by a pair of collars upon the latter, the inner of which collars seats against the annular shoulder in the bore of the body portion or section. (26th February, 1957).

5. A swivel coupling of the type herein specified, having the construction substantially as hereinbefore described with reference to and as illustrated by the accompanying drawings. (26th February, 1957).

EDWD. WATERS & SONS.
MELBOURNE.
Patent Attorneys for Applicant.

****

References.

Serial No.	Application No.	Classification.
---	15,784/09	31.9; 74.9.
---	4246/12	31.9.
---	13,167/19	31.9; 74.9.

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A. J. Arthur, Commonwealth Government Printer, Canberra.

223,587

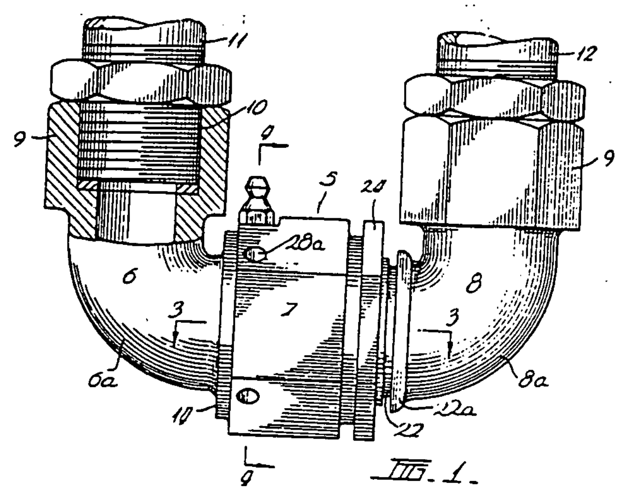


FIG. 1

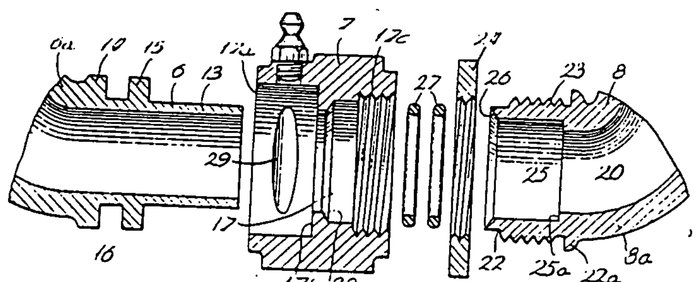


FIG. 2

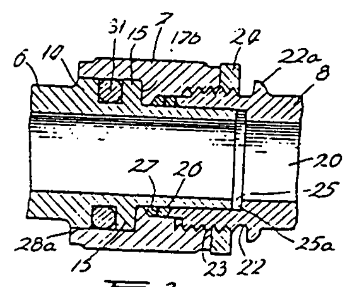


FIG. 3

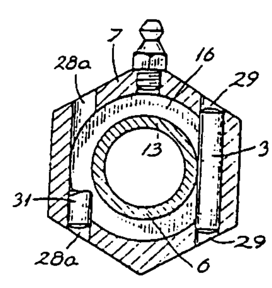


FIG. 4

(12) AUSTRALIAN PATENT ABRIDGMENT
(19) AU (11) AU-B-60886/80

532906

(54) BACKFLOW PREVENTING VALVE
(71) CHAS. M. BAILEY CO.
(21) 60886/80 532906 (22) 29.7.80
(24) 29.7.80
(43) 4.2.82 (44) 20.10.83
(51)3 F16K 15/02 F16K 17/04 F16K 31/365
(72) ROBERT W. DIXON
(74) DM
(56) 22930/77 F16K 15/03, 17/04, 31/126
US 4231387
US 4159025

(57) Claim

1. A backflow preventing valve comprising a first body portion terminating in a planar face, said first body portion having an inlet port and an outlet port both in alignment on a through first axis extending in a plane parallel to said planar face, means defining an inlet chamber in said first body portion open to said inlet port and also extending along a second axis disposed in said plane and intersecting said first axis, means defining an outlet chamber in said first body portion open to said outlet port and also extending along a third axis disposed in said plane and intersecting said second axis, means defining an intermediate chamber in said first body portion merging with said inlet chamber at an inlet valve seat centered in said plane and also merging with said outlet chamber at an outlet valve seat in said plane, an inlet valve in said intermediate chamber and having a valve stem movable in said plane toward and away from said inlet valve seat,

.../2

a first spring in said intermediate chamber urging said inlet valve toward said inlet valve seat, an outlet valve in said outlet chamber and having a valve stem movable in said plane toward and away from said outlet valve seat, a second spring in said outlet chamber urging said outlet valve toward said outlet valve seat, a second body portion terminating in a planar face, means for releasably holding said first body portion and said second body portion with said planar faces substantially coincident and parallel to said plane, means defining in said first body portion

an extension of said intermediate chamber disposed substantially perpendicular to said plane, means in said first body portion defining a vent valve seat surrounding said extension and substantially parallel to said plane, means defining in said second body portion a vent chamber extending perpendicular to said first plane and merging with said extension, means defining a vent to the atmosphere from said vent chamber, a vent valve having a stem movable in said extension normal to said plane and having on said stem a head movable into and

.../3

out of engagement with said vent valve seat, a planar cap plate on said vent valve stem and extending parallel to said plane, a spring interposed between said second body portion and said cap plate for urging said vent valve away from said vent valve seat, a planar diaphragm extending parallel to said plane and abutting said cap plate and said second body portion, a diaphragm cap overlying said planar diaphragm on the side thereof opposite said cap plate and thereby establishing a diaphragm chamber, means for securing said diaphragm cap through said planar diaphragm to said second body portion, and means for establishing an air passage substantially normal to said first plane and extending from said inlet chamber then through said first body portion and then through said second body portion and then through said diaphragm and said cap into said diaphragm chamber.

532006

COMMONWEALTH OF AUSTRALIA

PATENTS ACT 1952

COMPLETE SPECIFICATION

(Original)

FOR OFFICE USE

Class Int. Class

Application Number: 60886/80
Lodged:

Complete Specification Lodged:
Accepted:
Published:

Priority:

Related Art:

This document contains the amendments made under Section 49.

and is correct for printing.

Name of Applicant: CHAS. M. BAILEY CO.,

Address of Applicant: 1301 59th Street, Emeryville, California, United States of America.

Actual Inventor(s): Robert W. Dixon

Address for Service: DAVIES & COLLISON, Patent Attorneys, 1 Little Collins Street, Melbourne, 3000.

Complete specification for the invention entitled:

"BACKFLOW PREVENTING VALVE"

The following statement is a full description of this invention, including the best method of performing it known to us :-

The present invention relates to a backflow preventing valve for use primarily in domestic water circuits and is effective to preclude flow in a counter direction that might cause contamination.

Specifically the present invention provides a backflow preventing valve comprising a first body portion terminating in a planar face, said first body portion having an inlet port and an outlet port both in alignment on a through first axis extending in a plane parallel to said planar face, means defining an inlet chamber in said first body portion open to said inlet port and also extending along a second axis disposed in said plane and intersecting said first axis, means defining an outlet chamber in said first body portion open to said outlet port and also extending along a third axis disposed in said plane and intersecting said second axis, means defining an intermediate chamber in said first body portion merging with said inlet chamber at an inlet valve seat centered in said plane and also merging with said outlet chamber at an outlet valve seat in said plane, an inlet valve in said intermediate chamber and having a valve stem movable in said plane toward and away from said inlet valve seat, a first spring in said intermediate chamber urging said inlet valve toward said inlet valve seat, an outlet valve in said outlet chamber and having a valve stem movable in said plane toward and away from said outlet valve seat, a second spring in said outlet chamber urging said outlet valve toward said outlet valve seat, a second body portion

terminating in a planar face, means for releasably holding said first body portion and said second body portion with said planar faces substantially coincident and parallel to said plane, means defining in said first body portion an extension of said intermediate chamber disposed substantially perpendicular to said plane, means in said first body portion defining a vent valve seat surrounding said extension and substantially parallel to said plane, means defining in said second body portion a vent chamber extending perpendicular to said first plane and merging with said extension, means defining a vent to the atmosphere from said vent chamber, a vent valve having a stem movable in said extension normal to said plane and having on said stem a head movable into and out of engagement with said vent valve seat, a planar cap plate on said vent valve stem and extending parallel to said plane, a spring interposed between said second body portion and said cap plate for urging said vent valve away from said vent valve seat, a planar diaphragm extending parallel to said plane and abutting said cap plate and said second body portion, a diaphragm cap overlying said planar diaphragm on the side thereof opposite said cap plate and thereby establishing a diaphragm chamber, means for securing said diaphragm cap through said planar diaphragm to said second body portion, and means for establishing a passage substantially normal to said first plane and extending from said inlet chamber then through said first body portion and then through said second body portion and then through said diaphragm and said cap into said diaphragm chamber.

Preferably the valve includes a two-part body of glass-reinforced plastic having an inlet valve and an outlet valve in their respective chambers connected to an appropriate inlet port and outlet port. There is an intermediate or vent chamber between the two valves, such chamber being open to the atmosphere under control of a vent valve, the motion of which is controlled by a diaphragm arranged between an inner diaphragm chamber and an outer diaphragm chamber. A spring presses on the diaphragm from the inner diaphragm chamber. There is a pressure connection between the inlet chamber and the outer diaphragm chamber, and there is another pressure connection between the intermediate chamber and the inner diaphragm chamber. The vent valve opens to discharge to the atmosphere in the event pressure on the normally downstream side thereof exceeds the pressure on the normally upstream side thereof.

In the drawings:

Figure 1 is a side elevation of a backflow preventing valve, pursuant to the invention, incorporated in a fluid line;

Figure 2 is a plan of the valve installation of Figure 1;

Figure 3 is a cross-section, the plane of which is indicated by the line 3-3 of Figure 2;

Figure 4 is a cross-section, the plane of which is indicated by the line 4-4 of Figure 3; and

Figure 5 is a cross-secton, the plane of which is indicated by the line 5-5 of Figure 3.

The backflow preventing valve is preferably for incorporation into a fluid system, especially a hydraulic system including a hydraulic high pressure line 6 or pipe normally discharging into a hydraulic low pressure pipe 7 or line. Flow usually is in the direction of the arrows 8 from the high pressure side to the low pressure side. Under abnormal conditions, the pressure on the side 7 may increase substantially and tend, then, to cause flow from the pipe 7 toward the pipe 6. The material that flows backward from the pipe 7 toward the pipe 6 may be contaminated in some fashion and should not be permitted to enter into the line 6. It is in order to prevent such adverse usage and to discharge any such backflowing material that the present valve is employed. Preferably, the valve comprises a main body 9 made up of two principal portions 11 and 12, both preferably fabricated of a nonmetallic material, especially a fiberglass-reinforced plastic that is substantially inert to the atmosphere and to the liquids with which the valve might be utilized and which is adequately capable of withstanding the ordinary operating pressures.

At the inlet end, the device is provided with a special fitting 13 of similar material having threads 14 for connection to the pipe 6 and having a bolt flange 16 for connection to the remainder of the body, there being an intermediate O-ring 17 or seal. Similarly, the discharge end is comparably provided with a threaded fitting 18 held in position by bolts 19 and including an O-ring seal 21. With this arrangement, the fittings 13 and 18 can be positioned on the pipes 6 and 7, and the main body can then be inserted laterally therebetween, and finally the flange bolts can be tightened to afford a leak-proof

assembly. In this fashion, the assembly and disassembly of the unit with the pipeline can readily be accomplished. Furthermore, simply by changing the fittings 13 and 18, the particular size of pipe to which the unit is to be fastened can be changed.

Within the principal part 11 of the body there is an inlet port 22 opening into an inlet chamber 23. On the other end of the body there is an outlet port 24 opening from an outlet chamber 26, the ports 22 and 24 being in general transverse alignment on a through axis 27 corresponding generally with the axis of the pipes 6 and 7. The inlet chamber 23 is angled or canted to conform to the axis 28 of a portion 29 of an intermediate chamber 31 occupying the central portion of the body. The intermediate chamber portion 29 merges with the adjacent inlet chamber in an inlet valve seat 32 symmetrical with the axis 28 and shaped as an annular rim.

Designed to be seated on the rim is a valve washer 33 held in place on a poppet valve 34 by a washer 36 and a fastening screw 37. The poppet valve includes a cruciform stem 38 movable along the axis 28 within a guide 39. This is an intermediate chamber plug 41 having a threaded interengagement with the body portion 11 and being surrounded by an O-ring seal 42 to preclude leakage. A spring 43 surrounds the plug and bears against the valve disc so as to urge the disc against its seat with a predetermined degree of force. In one instance, the spring 43 requires a differential pressure across the valve seat 32 of some five or six pounds to open. There is a removable plug 46 which can readily be replaced by a

test cock or test gauge for initial testing and for testing from time to time after the unit has gone into service.

The intermediate chamber 31 merges at an outlet valve seat 47 with a portion 48 of the outlet chamber 26, this portion being symmetrical about an axis 49 extending approximately at right angles to the axis 28 and lying in the same plane as such axis and in the same plane as the through axis 27, so that the parts are compact and afford a short fluid travel distance through the valve. Although there is impact of the flowing fluid and any contained particles against the valve washers, such impact is of an angled or glancing nature when the valves are in open position. The short and reasonably direct flow path through the valve body tends to reduce turbulence and eddies within the device and, with the inclined or angled valves, tends to reduce impact wear and abrasion of the valve washers.

Of the same construction as the primary or inlet valve is an outlet valve 51 having a stem 52 guided in a plug 53 situated in the body portion 11 just as is the plug 41. Substantially the only difference is that a spring 54 surrounding the plug 53 is of somewhat lesser strength than the spring 43, responding to a pressure differential of only about two pounds for a full open motion. There is likewise a pipe plug 56 in the body plug 53 in order for a test cock or gauge to be supplied when desired.

As so far described, liquid flowing normally from the inlet toward the outlet is effective to lift the inlet valve

34 to flcw into the intermediate chamber 31, then to lift the outlet valve 51 and so to continue through the outlet chamber 26 and into the pipe 7. Conversely, if the pressure drop across the valve body should change its direction, then it would be expected that the outlet valve 51 would close, preventing any flow into the intermediate chamber from the outlet chamber. However, it occasionally happens that under adverse circumstances due to old age or adverse wear conditions or the like the valve 51 cannot be entirely relied upon to seat fully. There is thus some likelihood of leakage past the valve 51 into the intermediate chamber, wherein the pressure could be expected correspondingly to rise to a value greater than that in the inlet chamber 23, so that there might be leakage into the inlet also. This event is to be precluded under any circumstances. Consequently, the valve is supplemented from that as so far described.

Particularly as shown in Figures 4 and 5, one principal portion 11 of the valve body is augmented by an abutting portion 61 of the other principal portion 12 thereof. This abutting portion 61 is fabricated of a similar material and is removably assembled with the portion 11 by means of a pair of bolts 62 (Figures 3 and 5).

At the junction of the body portions 11 and 61 (Figures 4 and 5), there is provided a vent valve seat 63 surrounding an extension 64 of the intermediate chamber, whereas on the other side of the valve seat 63 there is formed in the abutting portion 61 a vent chamber 67 having a vent opening 68 leading to the atmosphere and preferably on the lower side of the vent chamber.

Adapted to seat on the vent valve seat 63 is a poppet vent valve 69 of a construction substantially the same as that of the inlet valve and the outlet valve, but in this instance having an enlarged, cylindrical stem 71 bearing an O-ring 72. The valve stem 71 is designed to reciprocate in a guide 73 projecting from the body portion 61 along the axis 74 of the vent valve. When the valve 69 is closed, there is no flow between the intermediate chamber 31 through the extension 64 into the vent chamber 67 and so through the vent opening 68 to the atmosphere. When the valve 69 is closed, there is no flow between the intermediate chamber 31 through the extension 64 into the vent chamber 67 and so through the vent opening 68 to the atmosphere. When the valve 69 is open, then there is easy flow from the intermediate chamber 31 through the vent chamber 67 and the opening 68 directly to the atmosphere. The pressure then in the intermediate chamber 31 is substantially atmospheric or slightly thereabove, so that there is no likelihood of any flow from the interior of the body 11 into the inlet line 6, and contamination is therefore completely prevented.

In order to actuate and control the vent valve 69, there is provided a diaphragm 76 of generally planar configuration lying against one face of the body portion 61 and overlain by a diaphragm cap 77 held in position by a number of fasteners 78. The diaphragm is thus well confined and defines an outer diaphragm chamber 79 and an inner diaphragm chamber 81. The stem 71 carries a cap plate 82 secured in position by a fastening screw 83.

There is a spring 84 in the inner diaphragm chamber 81 resting against the body portion 61 and against the cap plate 82.

As part of the diaphragm containing structure, including the body portion 61 and the cap 77, there is afforded a first passage 86 extending from the inlet chamber 23 through a sleeve connection 87 surrounded by an O-ring 88 and extending through an aperture 89 in the diaphragm itself the passage 86 goes to an extension passage 90 in the diaphragm cap 77, so that free communication is established between the inlet chamber 23 and the outer diaphragm chamber 79.

In a somewhat similar fashion, there is a second passage 91 partly in the body portion 11 and extending from the intermediate chamber 31 and through a sleeve 92 and O-ring seal 93 and through the rest of the passage 91 in the body portion 12 into the inner diaphragm chamber 81.

With this arrangement, the pressure in the inlet chamber 23 is imposed on the outer side of the diaphragm 76, whereas the pressure in the intermediate chamber 31 is imposed on the under or inner side of the diaphragm 76. This differential pressure taken into account with the pressure due to the spring 84, either maintains the diaphragm in its position substantially as shown in Figures 4 and 5 with the vent valve 69 closed, or under adverse circumstances the pressure inside the intermediate chamber 31, being relatively large, moves the diaphragm away from its position as shown and toward the diaphragm cap 77. This opens the vent valve 69 so that high pressure

fluid can discharge from the intermediate chamber 31 through the vent chamber and vent opening 68 to the atmosphere. There is an access plug 94 so that test fixtures or gauges or cocks can be connected into the outer diaphragm chamber 79.

With this arrangement, whenever there is a tendency to backflow due to a higher pressure in the outlet line 7 than there is upstream therefrom toward the inlet line 6, and even though the outlet valve 51 may have become defective and may leak and permit the extra or higher pressure into the intermediate chamber 31, nevertheless the presence of such excessive pressure within the chamber 31 is immediately communicated to the inner side of the diaphragm 76 and augments the pressure thereon due to the spring 84. If, then, the pressure on the other, outer side of the diaphragm in the outer chamber 79 and communicated thereto through the first passage 86 is still relatively low, then the differential pressure opens the vent valve 69 and permits all of the fluid downstream from the inlet valve 34 to discharge to the atmosphere through the vent opening 68, and there is no possibility of back or contaminating flow to the inlet pipe 6. When the differential pressure drops to a normal value, the parts return to their normal, illustrated positions.

With this arrangement, and since the valve is expected to serve for many years, it is quite possible at any time simply by removing the various bolts, such as 19, and very slightly spreading the pipes 6 and 7 to withdraw the backflow preventing valve laterally for bench

tests or the like. Equally simply, a properly conditioned valve can be reintroduced into the line and again bolted in position for further service. Also, because of the various plugs, the valve can be checked at any time by appropriate test techniques to make sure that it is in full and effective service operation.

Since the body of the valve is comprised of nonmetallic materials, there is no transmission of electrical voltages across or through the valve, so that some of the possible bad effects of electrolysis are greatly reduced. Furthermore, since the valve is of a plastic material that partakes of a very smooth surface finish, the pressure drop through the valve is somewhat less than is customary. Also, since the main body of the valve is made in two principal portions, the entire interior of the valve is subjected to ready access and complete and thorough visual inspection at all times. There has therefore been provided a relatively simple, economical and superior backflow preventing valve.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:-

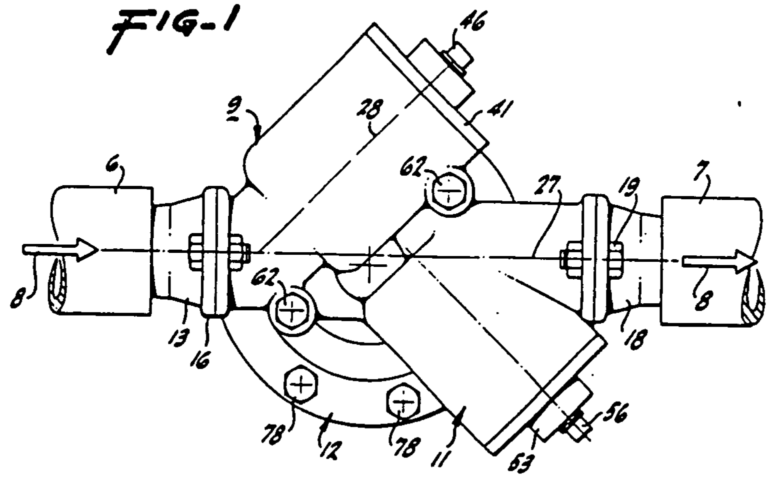
1. A backflow preventing valve comprising a first body portion terminating in a planar face, said first body portion having an inlet port and an outlet port both in alignment on a through first axis extending in a plane parallel to said planar face, means defining an inlet chamber in said first body portion open to said inlet port and also extending along a second axis disposed in said plane and intersecting said first axis, means defining an outlet chamber in said first body portion open to said outlet port and also extending along a third axis disposed in said plane and intersecting said second axis, means defining an intermediate chamber in said first body portion merging with said inlet chamber at an inlet valve seat centered in said plane and also merging with said outlet chamber at an outlet valve seat in said plane, an inlet valve in said intermediate chamber and having a valve stem movable in said plane toward and away from said inlet valve seat, a first spring in said intermediate chamber urging said inlet valve toward said inlet valve seat, an outlet valve in said outlet chamber and having a valve stem movable in said plane toward and away from said outlet valve seat, a second spring in said outlet chamber urging said outlet valve toward said outlet valve seat, a second body portion terminating in a planar face, means for releasably holding said first body portion and said second body portion with said planar faces substantially coincident and parallel to said plane, means defining in said first body portion

an extension of said intermediate chamber disposed substantially perpendicular to said plane, means in said first body portion defining a vent valve seat surrounding said extension and substantially parallel to said plane, means defining in said second body portion a vent chamber extending perpendicular to said first plane and merging with said extension, means defining a vent to the atmosphere from said vent chamber, a vent valve having a stem movable in said extension normal to said plane and having on said stem a head movable into and out of engagement with said vent valve seat, a planar cap plate on said vent valve stem and extending parallel to said plane, a spring interposed between said second body portion and said cap plate for urging said vent valve away from said vent valve seat, a planar diaphragm extending parallel to said plane and abutting said cap plate and said second body portion, a diaphragm cap overlying said planar diaphragm on the side thereof opposite said cap plate and thereby establishing a diaphragm chamber, means for securing said diaphragm cap through said planar diaphragm to said second body portion, and means for establishing an air passage substantially normal to said first plane and extending from said inlet chamber then through said first body portion and then through said second body portion and then through said diaphragm and said cap into said diaphragm chamber.

2. A backflow valve substantially as herein described with reference to the accompanying drawings.

DATED this 30th day of August, 1983.
CHAS. M. BAILEY CO.,
by its Patent Attorneys,
DAVIES & COLLISON.

FIG-1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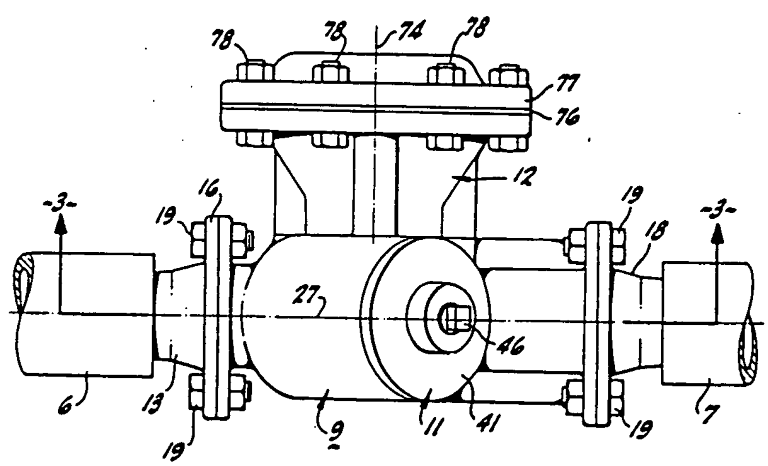
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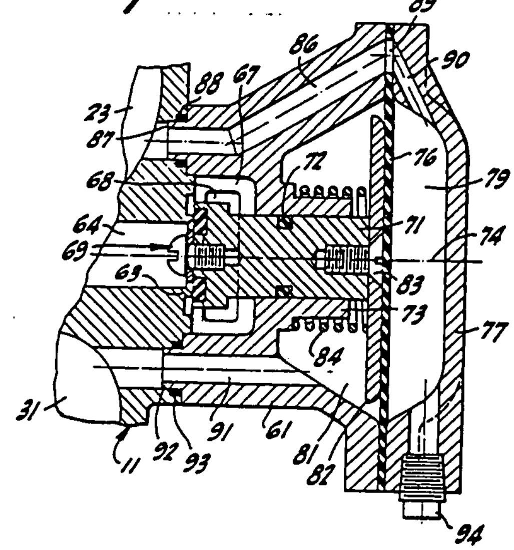
FIG-2

FIG-4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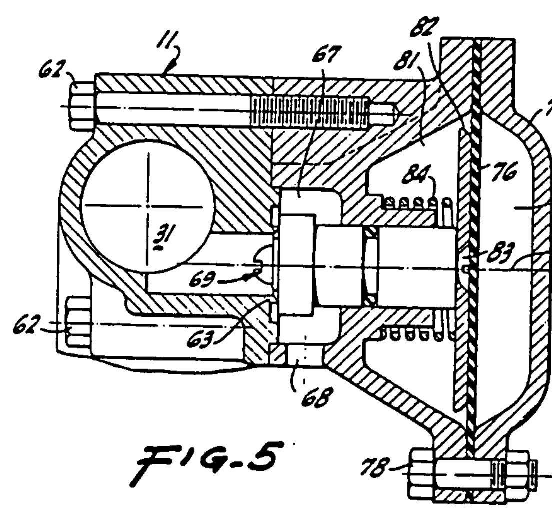
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FIG-5

EP 10667 -2- F16K 27/0214

RÉPUBLIQUE FRANÇAISE

MINISTÈRE DE L'INDUSTRIE

SERVICE de la PROPRIÉTÉ INDUSTRIELLE

BREVET D'INVENTION

P.V. n° 39.657, Rhône

N° 1.231.542

Classification internationale : F 06 k

I05 #9

Robinet à soupape.

Société anonyme dite : ÉTABLISSEMENTS FRANCIS GUICHON et Société en nom collectif dite : ÉTABLISSEMENTS TRUCHOT & Cie résidant : la 1re en France (Savoie) ; la 2e en France (Rhône).

Demandé le 3 août 1959, à 15h 35m, à Lyon.

Délivré le 11 avril 1960. — Publié le 29 septembre 1960.

L'entretien, la répartition et l'échange des pièces défectueuses dans les robinets, notamment ceux utilisés dans les industries chimiques, constituent des opérations délicates qui arrêtent toujours trop longtemps les fabrications.

L'invention remédie à cet inconvénient. Elle a pour objet un robinet à soupape dont le corps est constitué essentiellement de deux parties, à savoir : le corps proprement dit dans lequel se déplace le clapet, et une embase servant de support au siège contre lequel porte le clapet.

Suivant une forme d'exécution de ce robinet, son corps proprement dit comporte une bride de raccordement, une tubulure de sortie avec raccordement à bride et collet, des moyens de guidage pour la tige porte-clapet et des colonnettes supportant l'écrou de manœuvre et son volant, la tige porte-clapet se vissant dans cet écrou. Quant à l'embase, elle porte non seulement le siège du clapet, mais aussi une tubulure d'arrivée avec son dispositif de raccordement par bride et collet.

Suivant une autre caractéristique de l'invention, l'embase du corps du robinet est avantageusement disposée dans un plan formant un angle, de préférence de 45°, avec l'axe de la tubulure d'arrivée solidaire de cette embase. L'embase portant le siège du clapet, et la bride de raccordement du corps étant fixées entre elles par boulonnage, il est alors possible de donner aux tubulures d'arrivée et de sortie des directions relatives différentes dont le nombre est égal au nombre de boulons de fixation de l'embase et de la bride précitées. C'est ainsi notamment qu'il est possible, entre autres, de donner aux tubulures d'arrivée et de sortie des directions coaxiales ou, au contraire, orthogonales.

De toute façon, l'invention sera bien comprise à l'aide de la description qui va suivre, en référence au dessin schématique annexé représentant, à titre d'exemple non limitatif, une forme d'exécution de ce robinet :

Figures 1 et 2 en sont des vues en perspective dans deux positions d'utilisation;

Figure 3 est une vue longitudinale du robinet dans sa position représentée à la figure 1.

Ce robinet à soupape est essentiellement constitué, pour son corps, par deux éléments respectivement *2* et *3*.

L'élément *2* forme le corps proprement dit du robinet. Il consiste en un tube comportant un fond *4* et se terminant par une bride *5*. Le fond *4* est percé, dans sa partie centrale, pour permettre le passage de la tige *6* portant le clapet *7*. Un presse-étoupe *8* est prévu.

L'élément *3* est constitué par une embase fixée à la bride *5* du corps *2* par des boulons *9*. Cette embase *3* sert de support au siège *10* du clapet *7*. De cette embase *3* est solidaire la tubulure d'arrivée *12* dont l'axe fait un angle de 45° avec l'axe du corps *2*. Cette tubulure *12* se termine par une bride filetée *13* sur laquelle se visse un collet de raccordement *14*.

La tubulure de sortie *15* débouche dans le corps *2* et fait corps avec celui-ci. Son axe fait lui-même un angle de 45° par rapport à l'axe de ce corps. Cette tubulure *15* se termine par une bride filetée *16* sur laquelle se visse un collet de raccordement 17.

Dans le cas représenté au dessin, la tige *6* portant le clapet *7* est commandée par un volant *18* solidaire d'un écrou *19* vissé sur l'extrémité filetée *6a* de la tige *6*. Cet écrou *19* est monté libre en rotation dans une douille *21* solidaire d'une barrette *22* portée par des colonnettes *23* fixées sur le fond *4* du corps *2*. Ces colonnettes servent de guidage à une barrette *24* qui, solidaire de la tige porte-clapet *6*, l'empêche de tourner, de telle sorte que la rotation du volant *18* et donc de l'écrou *19* se traduit par un déplacement de translation de la tige porte-clapet *6*.

Ce robinet à soupape présente les principaux avantages suivants :

Pour accéder au siège *10* et au clapet *7*, il suffit de dégager les boulons *9* ce qui permet de séparer le corps *2* et l'embase *3*;

La réparation éventuelle d'un organe du robinet après ouverture, c'est-à-dire après séparation du corps *2* et de l'embase *3* est facile, car il est beaucoup plus aisé de fixer sur un tour l'un de ces deux éléments que l'ensemble du robinet;

Cette conception démontable du robinet facilite son uisinage primitif et donc abaisse son prix de revient;

Au bout d'une longue durée de service la remise à neuf du robinet est peu onéreuse, car il suffit de remplacer l'embase *10* et le clapet *7* au lieu de remplacer l'ensemble du robinet;

La disposition de l'embase *3* par rapport à la tubulure d'arrivée *12* permet de donner aux tubulures *12* et *15* des orientations différentes en nombre égal à celui des boulons *9*; c'est ainsi qu'à titre d'exemple le robinet est représenté aux figures 1 et 3 dans une position où les brides *13* et *16* respectivement d'arrivée et de départ sont dans des plans parallèles, tandis qu'à la figure 2 elles sont dans des plans orthogonaux.

Comme il va de soi, l'invention ne se limite pas à la seule forme d'exécution de ce robinet à soupape qui a été ci-dessus indiquée à titre d'exemple; elle en embrasse, au contraire, toutes les variantes de réalisation.

RÉSUMÉ

1° Robinet à soupape, caractérisé en ce que son corps est constitué essentiellement de deux parties, à savoir : le corps proprement dit dans lequel se déplace le clapet, et une embase servant de support au siège contre lequel porte le clapet.

2° Forme d'exécution du robinet à soupape spécifié en 1° caractérisée par les points suivants pris ensemble ou séparément :

a. Son corps proprement dit comporte une bride de raccordement, une tubulure de sortie avec raccordement à bride et collet, des moyens de guidage pour la tige porte-clapet et des colonnettes supportant l'écrou de manœuvre et son volant, la tige porte-clapet se vissant dans cet écrou;

b. Son embase porte non seulement le siège du clapet, mais aussi une tubulure d'arrivée avec son dispositif de raccordement par bride et collet;

c. Son embase est disposée dans un plan formant un angle, de préférence de 45°, avec l'axe de la tubulure d'arrivée solidaire de cette embase.

3° A titre de produit industriel nouveau, tout robinet à soupape tel que spécifié en 1° ou en 2°, ou comportant application, totale ou partielle, de semblables dispositions.

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ÉTABLISSEMENTS FRANCIS GUICHON
et Société en nom collectif dite :
ÉTABLISSEMENTS TRUCHOT & C^ie^

Par procuration :
GERMAIN et MAUREAU

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Établissements Francis Guichon

et Société en nom collectif dite : Établissements Truchot & Cie

Fig. 1

Fig. 2

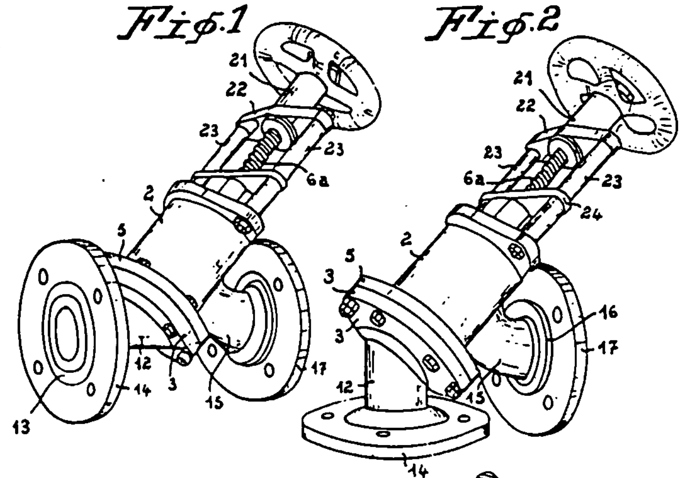
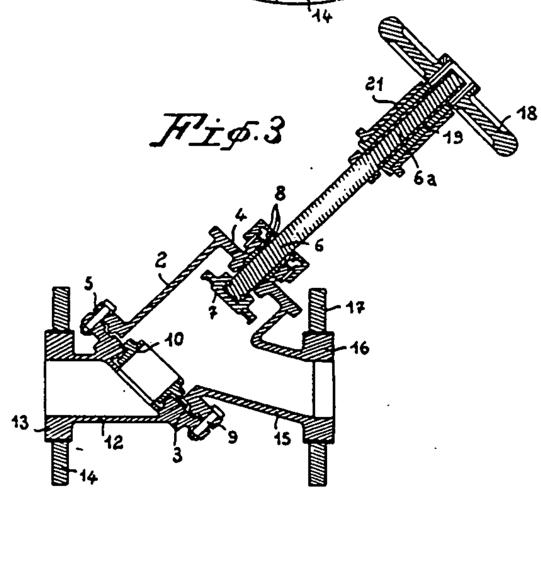


Fig. 3



PATENT SPECIFICATION (11) 1 490 553

1 490 553

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(31) Convention Application No. 410 173 (32) Filed 26 Oct. 1973 in
(33) United States of America (US)
(44) Complete Specification published 2 Nov. 1977
(51) INT. CL.² F16K 15/02
(52) Index at acceptance
F2V J4X L4D L6C L8C

THE PATENT OFFICE LONDON

(54) IMPROVEMENTS RELATING TO FLUID FLOW APPARATUS

(71) We, GRISWOLD CONTROLS, a corporation organised and existing under the laws of the State of California, United States of America, of 124 East Dyer Road, Santa Ana, State of California, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to fluid flow apparatus and is particularly directed to improvements in check valve construction and backflow prevention apparatus.

Check valves are commonly provided when it is desired to permit fluid flow in one direction but to prevent fluid flow in the other direction. A single check valve acting alone may leak slightly and, therefore, single check valves are not used when it is necessary to prevent any reverse flow, even in the smallest degree. In the latter situation, backflow prevention apparatus may take the form of two check valves connected in series with a "zone" between them. Both check valves remain open during normal flow in a forward direction, but in the event that downstream pressure should approach the upstream pressure within a predetermined amount, for example, two pounds per square inch, the volume of the zone between the check valves is vented to atmosphere. In such devices, downstream pressure can never exceed upstream pressure, even under vacuum conditions with the result that reverse flow is not possible.

Backflow prevention devices of the type just described have at least two serious shortcomings. The first is that in order to have a check valve which will close satisfactorily, and more significantly, in certain cases, maintain a predetermined minimum pressure, a spring force is used, and this must be overcome during normal flow in the forward direction. Unfortunately, this often results in a pressure drop of serious proportions, particularly when two check valves in series are employed. Another difficulty is that conventional apparatus for venting the zone between the check valves is usually costly, inaccurate and difficult to maintain.

According to the invention, there is provided a check valve comprising an inlet passage terminating in an annular valve seat, a barrel coaxial with the valve seat and of larger diameter than the valve seat, a valve poppet having a flange slidably guided within the barrel and being axially movable towards and away from said valve seat, a spring arranged to urge the poppet towards sealing contact with the valve seat, a chamber bounded in part by the poppet remote from the valve seat, and an outlet passage, wherein a portion of said flange projects into the outlet passage to define a region in the fluid flow path in which the velocity of flowing fluid in use is greater than in the rest of the outlet passage and the pressure is correspondingly less and wherein the chamber communiciates with said region whereby increasing flow of fluid through the check valve from the inlet passage to the outlet passage in use causes a reduction in pressure in the chamber to oppose the action of the spring.

The invention also extends to a check valve assembly comprising a check valve as defined above connected in series with another check valve as defined above, the outlet passage of one check valve forming the inlet passage of the other check valve.

The invention also provides a backflow preventer assembly comprising two check valves as defined above connected in series and defining a zone between them, and means including a control valve actuable to vent said zone to atmosphere, said control valve having means responsive to differential pressure across the upstream check valve for actuating said control valve.

Preferably, the control valve comprises a housing provided with a valve seat, a stem mounted to move axially in the housing and having a valve head movable to close against said seat, a cover, a flexible diaphragm having its periphery clamped between the cover and the housing and acting to define a chamber in the housing and a chamber in the cover, means connecting the central portion of the diaphragm to the stem, a spring in the cover chamber urging the stem in a direction to open the valve, a discharge pipe

connecting the zone to [illegible]d housing, a first pressure sensing line communicating the pressure in the inlet passage of the upstream check valve to the housing chamber and a second pressure sensing line communicating the pressure in the outlet passage of the upstream check valve with the cover chamber, and a balance piston fixed on the stem slidably mounted within the housing to balance the fluid pressure force from the discharge pipe tending to move the valve head away from the valve seat.

Certain embodiments of the invention will now be described by way of example and with reference to the accompanying drawings, in which:

Figure 1 is a sectional elevation showing a first check valve according to the invention;

Figure 2 is a sectional elevation of a second check valve according to the invention;

Figure 3 is a sectional elevation of a third check valve according to the invention;

Figure 4 is a sectional elevation of a fourth check valve according to the invention;

Figure 5 is a sectional elevation showing a double check valve assembly according to the invention, both check valves being shown in the closed position;

Figure 6 is a chart showing pressure loss plotted against flow rate in a commercial form of the double check valve assembly of Figure 5. One curve of the graph relates to a device of three-quarter inch nominal size and the other curve relates to a device of one inch nominal size;

Figure 7 is a side elevation showing a backflow preventer assembly according to the invention;

Figure 8 is an end elevation of the assembly of Figure 7.

Figure 9 is a schematic diagram in sectional elevation of the assembly of Figure 7, the parts being shown in position for full flow in the forward direction;

Figure 10 is a chart showing pressure loss plotted against flow rate for the backflow preventer assembly of Figures 7-9. One curve of the graph relates to a device of three-quarter inch nominal size and the other curve relates to the one inch nominal size;

Figure 11 is a sectional view showing a modified form of differential pressure control valve of the backflow preventer assembly, the parts being positioned for normal forward flow; and

Figure 12 is a view similar to Figure 11, the parts being shown in position corresponding to backflow conditions.

Referring to the drawings, a check valve assembly generally designated 10 is shown in various embodiments in Figures 1, 2, 3 and 4. The check valve assembly 10 includes a poppet 11 slidably mounted within a stationary barrel 12. An annular resilient ring 13 serves as a valve face and is held in place on the poppet 11 by means of a retaining washer 14 and a threaded fastening 15. A coil compression spring 17 acts on the poppet 11 to bring the resilient ring 13 into sealing engagement with a stationary annular seat 18 provided at the end of an inlet passage 19. The barrel 12 is of larger diameter than the valve seat 18.

The poppet 11 has a first flange 20 and a second flange 21 both slidably mounted within the stationary barrel 12. An annular groove 22 is defined between the flanges 20 and 21 and one or more ports 23 establish communication between the groove 22 and a spring chamber 24. Flange 20 and ring 13 define a generally annular space 29 with the seat 18. In Figure 1, the inlet terminal 26 and the outlet terminal 27 are coaxial, and the axis of movement of the poppet 11 is positioned at about 45° with respect thereto. In Figure 2, the inlet terminal 26*a* and the outlet terminal 27*a* are at right angles, and the axis of movement of the poppet 11 is coaxial with the inlet terminal 26*a*. In Figure 3, the inlet terminal 26*b* and the outlet termianl 27*b* are coaxial, and the axis of movement of the poppet 11 is at right angles thereto. In Figure 4, the inlet terminal 27*c* and the outlet terminal 27*c* are coaxial, and the movement of the poppet 11 is along the same axis.

The check valve assembly 10 is in open position as shown in Figures 1, 2, 3 and 4. Fluid in the inlet passage 19 passes between th annular seat 18 and the resilient ring 13 into the outlet passage 28. Inlet pressure is then present in the space 29 acting upon the total pressure area of flange 20 to overcome the force of spring 17. Thus, flange 20 effectively serves as a seal between the space 29 and groove 22. In Figure 4, a stationary housing 30 encircles the barrel 12 and passageways 31 are provided to carry fluid from the space 29 to the outlet terminal 27*c*.

In each case the outer diameters of the poppet flanges 20 and 21 are substantially larger than the effective diameter of the stationary seat 18, so that when the check valve is in closed position with the resilient ring 13 engaging the seat 18, the pressure in the inlet passage 19 acts over a substantially smaller area than the pressure in the spring chamber 24. When the pressure in the inlet passage 19 applied to the area of seat 18 is sufficient to overcome the force of the spring 17 and the pressure in the spring chamber 24, both the static and dynamic head are subsequently applied to the larger effective area of the flange 20. Thus, the increase in effective area when the valve first opens results in a substantial force to overcome the spring force, and the valve moves positively towards the open position.

When the check valve parts are in open position corresponding to forward flow

operation, as shown in Figure 4, the flow of the fluid creates a low pressure region around the poppet 11 in the groove 22. This occurs because a portion of the flange 20 and a portion of the groove 22 extend into the outlet passage 28. This reduced pressure is transmitted to the spring chamber 24 through the groove 22 and through the port or ports 23. Consequently, as the velocity of forward flow increases, the pressure in the chamber 17 acting on the effective area defined by the diameter of flange 21 decreases.

When the pressure drop across the valve falls below a predetermined value, the portion of the poppet 11 which protrudes into the outlet passage 28, Figures 1-3, and the entire poppet in Figure 4, receives the full pressure of the fluid in outlet passage 28, and the pressure thus developed acts over the full effective area of the spring chamber 24, which combined with the force of the spring 17 acts to close the valve promptly.

It will be observed that, in the construction just described, as the velocity of forward flow increases, the velocity head produces a positive opening force on the poppet 11 on the side containing the resilient ring 13 together with a lowering of pressure in the chamber 24, both effects serving to overcome the force of the spring 17. Moreover the lowering of pressure in the spring chamber is developed due to the portion of the poppet flange 20 protruding into the outlet passage 28 and creating a restriction 77 in which the momentum of fluid flow acting upon the static fluid in groove 22 results in the lowering of pressure in groove 22 and transmitted to the spring chamber through the communicating port 23. Consequently, as the demand for flow increases, the resulting momentum increase results in an ever decreasing pressure in the spring chamber. Concurrently, as the rate of flow increases, the velocity head acting upon the full effective area of flange 20 (on the side with the resilient seal) increases. With both effects thus combined, a substantial pressure differential is created across the flange 20 to create an increasing force to overcome the force of the spring. Furthermore, even with the introduction of restriction 77 and a consequent "induced" pressure drop at that point, the net result is an advantageous pressure differential across the poppet and a reduction in the total pressure drop across the valve. Moreover, the spaced flanges 20 and 21 guide the poppet in its movements within the barrel 12 with adequate clearances to avoid mechanical frictional losses to minimize mechanical malfunctions. The absence of guide pins, toggle levers, etc., also assists in the reduction of mechanical friction.

The double check valve assembly generally designated 33, shown in Figure 5, employs two duplicate check valve assemblies $10a$ and $10b$ which are sub. atially the same as the check valve 10 described in detail above. These check valve assemblies are arranged at right angles to each other and positioned at 45° to the axis of the inlet terminal 34 and the outlet terminal 35. The construction and operation of each of these check valve assemblies $10a$ and $10b$ is the same as that of the check valve assembly 10 described above. Moreover, the geometric relationship of the assemblies $10a$ and $10b$ as shown in Figure 5 produces a uniform flow pattern by minimizing the extent of the changes in direction of flow and the extent of obstructions to forward flow, thus minimizing fluid pressure losses.

The chart of Figure 6 shows the pressure loss through the double check valve assembly of Figure 5, for both the nominal size of three-quarter inch and the nominal size of one inch. It will be observed that the pressure loss through the assemblies actually falls off as the flow rate increases, up to about 15 gallons per minute for the three-quarter inch size and up to about 18 gallons per minute for the one inch size.

It will be observed that the moving parts of each check valve assembly $10a$ and $10b$ may be installed and removed independently without any need to disconnect the entire assembly from the line. Moreover, each check valve assembly is so arranged as to utilize the full impact of the dynamic pressure in the supply line when in forward flow operation, for effectively minimizing hydraulic pressure losses. Furthermore, each check valve assembly is so arranged as to have portions of the poppet thereof protruding into its respective discharge passage, or in communication with its discharge passage, so as to be responsive to the slightest reverse flow action, closing rapidly to prevent backflow.

The backflow preventer asssembly shown in Figures 7, 8 and 9 includes a double check valve assembly 33 having its inlet terminal 34 connected to a supply pipe 36 through a shutoff valve 37 and a union coupling 38. The outlet terminal 35 of the double check valve assembly 33 is connected through union coupling 39 and shutoff valve 40 to the service pipe 41.

A control valve assembly 43 is connected to the double check valve assembly 33 by means of discharge pipe 44 and pressure-sensing lines 45 and 46. The discharge pipe 44 forms a portion of a stationary housing 47 which contains a removable valve seat 48. A valve stem 49 carries a valve head 50 at its lower end and a resilient disc 51 on the valve head closes against the seat 48. When the parts are in position as shown in Figure 9, the valve is closed and therefore discharge of fluid from the port 52 in the double check valve assembly 33 through discharge pipe 44

is prevented. The port 52 is located downstream from the check valve 10*a* and upstream from the check valve 10*b*.

Means are provided for moving the stem 49 to open or close the valve 48, 50, and as shown in the drawings this means includes a flexible diaphragm 54 having its outer periphery clamped between a flang 55 on the housing 47 and a flange 56 on a cover 57. The inner portion of the diaphragm 54 is clamped to the stem 49 between plates 58 and 59. A seal ring 60 on the stem 49 slides within a housing bore 61, and a seal ring 62 on an annular piston 63 of the stem 49 slides within the housing bore 64.

A chamber 65 is formed within the housing 47 below the diaphragm 54 and a chamber 66 is formed above the diaphragm within the cover 57. The chamber 65 communicates through passage 46 and port 67 with the inlet passage 68 of the check valve assembly 10*a*. The chamber 66 is connected through a cover port 69, passage 45 and a port 70 with an inlet passage 71 for the check valve assembly 10*b*. From this description it will be understood that the differential pressure acros the diaphragm 54 is the same as the differential pressure between the inlet passage 68 and the inlet passage 71.

A coil compression spring 73 in the chamber 66 acts on the diaphragm plate 58 to urge the stem 49 in a direction to open the discharge valve 48, 50. The force of the spring is assisted by the pressure in the chamber 66 and is opposed by the pressure in the chamber 65. This opposition force is increased by the fluid pressure acting against the underside of the annular piston 63. The annular space above the piston 63 and within the housing 47 is vented to atmosphere through vent port 74.

In operation, the differential control valve 43 serves to vent the zone between th check valve assemblies 10*a* and 10*b* through the discharge port 52 whenever the downstream pressure approaches the upstream pressure within a predetermind amount. Thus for example, the parts may be designed and adjusted so that when the pressure in the inlet terminal 34 is less than 2 psi greater than the pressure in the outlet terminal 35, the differential control valve 43 will open to permit fluid to flow from the zone port 52 through the pipe 44 and through the open valve 48, 50 to atmosphere. The several forces applied to the stem 49 in addition to gravity are the opposing forces developed by inlet pressure reflected in chamber 65, outlet pressure reflected in chamber 66, zone pressure at port 52 reflected against piston 63, as well as on discharge valve 50, and the force of spring 73.

It will be observed that the effective area of the diaphragm 54 is much greater than that of the valve seat 48. Also, the ports 67 and 70 are angularly positioned to reflect both static and dynamic pressures in their respective passages. Accordingly, the differential control valve 43 causes fluid to be vented out through zone port 52 whenever the outlet passage pressure from check valve assembly 10*a* (reflected through line 45) plus the force of the spring 76, plus the effect of gravity, exceeds the inlet passage from passage 68 (reflected through line 46) acting in chamber 65. The balance piston 63 has the same effective area as that of the seat 48, plus that of the communicating stem 49, so that the pressure exerted on the valve head 50 and the sliding stem 49 is balanced out by the pressure exerted on the piston 63. In similar fashion, the differential control valve 43 remains closed to prevent loss of fluid through the zone port 52 so long as the total force generated by inlet pressure in the chamber 65 exceeds the sum of the force generated by outlet pressure in chamber 66 supplemented by the force of the spring 73 and by the effect of gravity.

The chart of Figure 10 shows the pressure loss through the backflow preventer assembly shown in Figures 7 to 9, for both the nominal size of three-quarter inch and the nominal size of one inch, when normal flow occurs in the forward direction. It will be observed that the pressure loss through the entire backflow preventer assembly actually falls off as the flow rate increases up to about 20 gallons per minute for the one inch size.

In the modified form of differential control valve shown in Figures 11 and 12, an axial passage 75 in the stem 49*a* replaces the cover port 69. This passage 75 and its side outlet port 76 establishes communication between the cover chamber 66 and the discharge pipe 44. Only one sensing line 46 is used, and it connects the chamber 65 through line 46 to the inlet passage 68, as described above. The sensing line 45 and port 70 are not used. Figure 11 shows the parts of the differential control valve in closed position corresponding to normal forward flow operation, and Figure 12 shows the same parts in position to discharge fluid from the zone port 52 to atmosphere when backflow conditions are present or imminent. In other respects, the construction and operation of the modified form of the differential control valve shown in Figures 11 and 12 are the same as those previously described.

Thus it may be seen that the invention, at least in its preferred embodiments, provides a check valve suitable for use in backflow prevention apparatus and which is constructed to provide a relatively high initial resistance to flow and yet as the flow increases provides a reduced pressure drop across the valve.

The invention also provides a pair of series-connected check valves in combination

with a differential control valve for venting the zone between the check valves when the downstream pressure approaches the upstream pressure within a predetermined amount.

WHAT WE CLAIM IS:—

1. A check valve comprising an inlet passage terminating in an annular valve seat, a barrel coaxial with the valve seat and of larger diameter than the valve seat, a valve poppet having a flange slidably guided within the barrel and being axially movable towards and away from said valve seat, a spring arranged to urge the poppet towards sealing contact with the valve seat, a chamber bounded in part by the poppet remote from the valve seat, and an outlet passage, wherein a portion of said flange projects into the outlet passage to define a region in the fluid flow path in which the velocity of flowing fluid in use is greater than in the rest of the outlet passage and the pressure is correspondingly less and wherein the chamber communicates with said region whereby increasing flow of fluid through the check valve from the inlet passage to the outlet passage in use causes a reduction in pressure in the chamber to oppose the action of the spring.

2. A check valve as claimed in claim 1 in which the spring comprises a coil compression spring mounted within said chamber.

3. A check valve as claimed in claim 1 or 2 wherein said poppet has two axially spaced flanges slidably guided within said barrel and defining an annular groove between the flanges, the groove communicating with said region, and at least one passage communicating the groove with the chamber.

4. A check valve as claimed in any preceding claim in which the inlet passage is provided with an inlet terminal and the outlet passage is provided with an outlet terminal.

5. A check valve as claimed in claim 4 in which said terminals are axially aligned.

6. A check valve as claimed in claim 5 in which the axis of movement of said valve poppet is perpendicular to the axis of said terminals.

7. A check valve as claimed in claim 5 in which the axis of movement of said valve poppet is disposed at an angle of about 45° with respect to the axis of said terminals.

8. A check valve as claimed in claim 5 in which the axis of movement of said valve poppet is the same as the axis of said terminals.

9. A check valve as claimed in claim 4 in which the axes of said terminals are disposed at right angles, and wherein the axis of movement of said valve poppet is the same as the axis of said inlet terminal.

10. A check valve substantially as hereinbefore described with reference to any of Figures 1 to 4 of the accompanying drawings.

11. A check valve assembly comprising a check valve as claimed in any preceding claim connected in series with another check valve as claimed in any preceding claim, the outlet passage of one check valve forming the inlet passage of the other check valve.

12. A check valve assembly as claimed in claim 11 in which the inlet passage of one check valve is provided with an inlet terminal and the outlet passage of the other check valve is provided with an outlet terminal, said terminals being axially aligned, and the axes of movement of the valve poppets being disposed substantially at 45° with respect to the axis of said terminals and being substantially perpendicular to each other.

13. A check valve assembly substantially as hereinbefore described with reference to Fig. 5 of the accompanying drawings.

14. A backflow preventer assembly comprising two check valves as claimed in any of claims 1 to 10 connected in series and defining a zone between them, and means including a control valve actuable to vent said zone to atmosphere, said control valve having means responsive to differential pressure across the upstream check valve for actuating said control valve.

15. An assembly as claimed in claim 14 including a first port arranged for sensing both static and dynamic heads in the inlet passage of the upstream check valve, and also including a second port arranged for sensing the pressure in the outlet passage of the same check valve.

16. An assembly as claimed in claim 15 wherein the second port is arranged for sensing both static and dynamic heads in the outlet passage of the upstream check valve.

17. An assembly as claimed in claim 15 or 16 wherein said control valve comprises a housing provided with a valve seat, a stem mounted to move axially in the housing and having a valve head movable to close against said seat, a cover, a flexible diaphragm having its periphery clamped between th cover and the housing and acting to define a chamber in the housing and a chamber in the cover, means connecting the central portion of the diaphragm to the stem, a spring in the cover chamber urging the stem in a direction to open the valve, a discharge pipe connecting the zone to said housing, a first pressure sensing line communicating the first port with the housing chamber and a second pressure sensing line communicating the second port with the cover chamber, and a balance piston fixed on the stem slidably mounted within the housing to balance the fluid pressure force from the discharge pipe tending to move the valve head away from the valve seat.

18. An assembly as c ied in claim 17 wherein said second pressure sensing line comprises a passage in the stem communicating the cover chamber with the interior of the housing.

19. A backflow preventer assembly substantially as hereinbefore described with reference to any Figures 7 to 12 of the accompanying drawings.

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15-19 Kingsway,
London, WC2B 6UZ.

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1490553 COMPLETE SPECIFICATION

5 SHEETS This dr ng is a reproduction of the Original on a reduced scale

Sheet 1

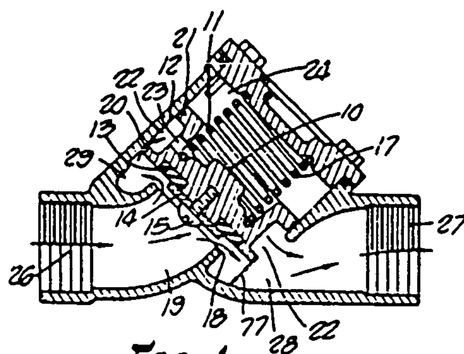
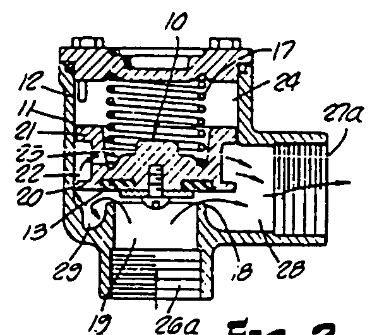


FIG. 1.



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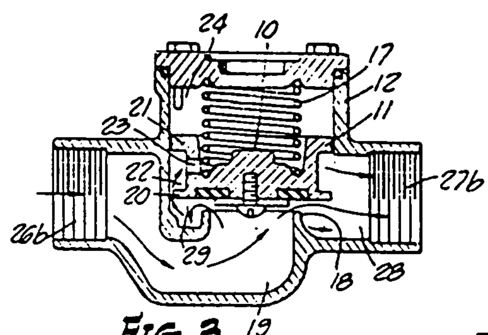

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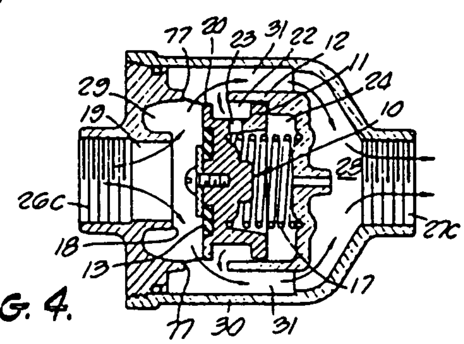
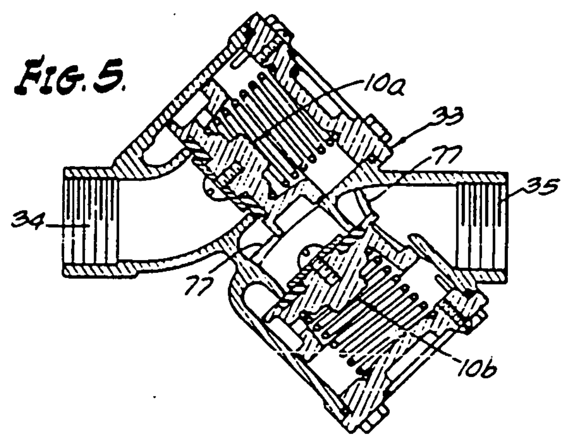


FIG. 4.

FIG. 5.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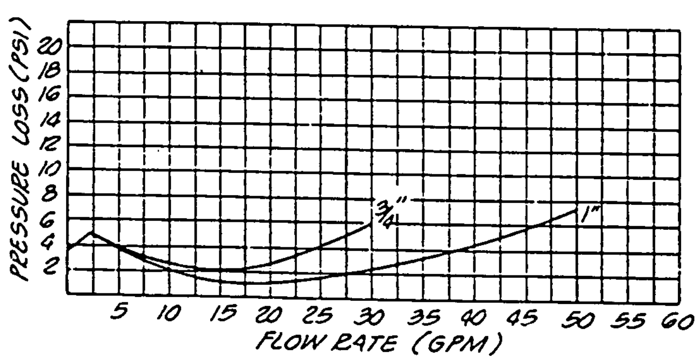
PRESSURE LOSS (PSI)
20
18
16
14
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6
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5 10 15 20 25 30 35 40 45 50 55 60
FLOW RATE (GPM)

FIG. 6.

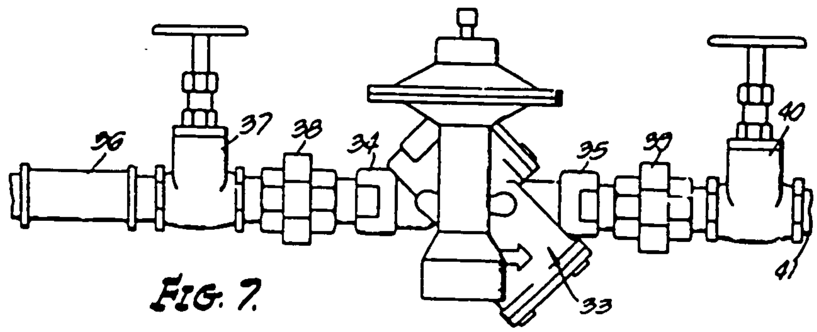

FIG. 7.

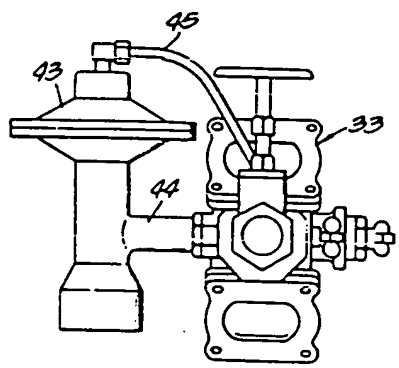

FIG. 8.

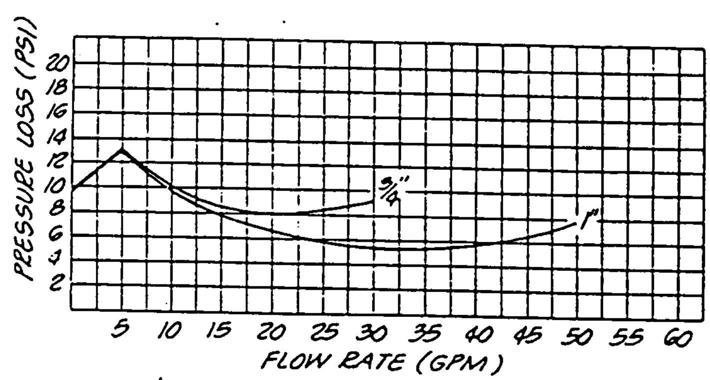

FIG. 10.

1490553 COMPLETE SPECIFICATION

5 SHEETS This drawing is a reproduction of the Original on a reduced scale

Sheet 4

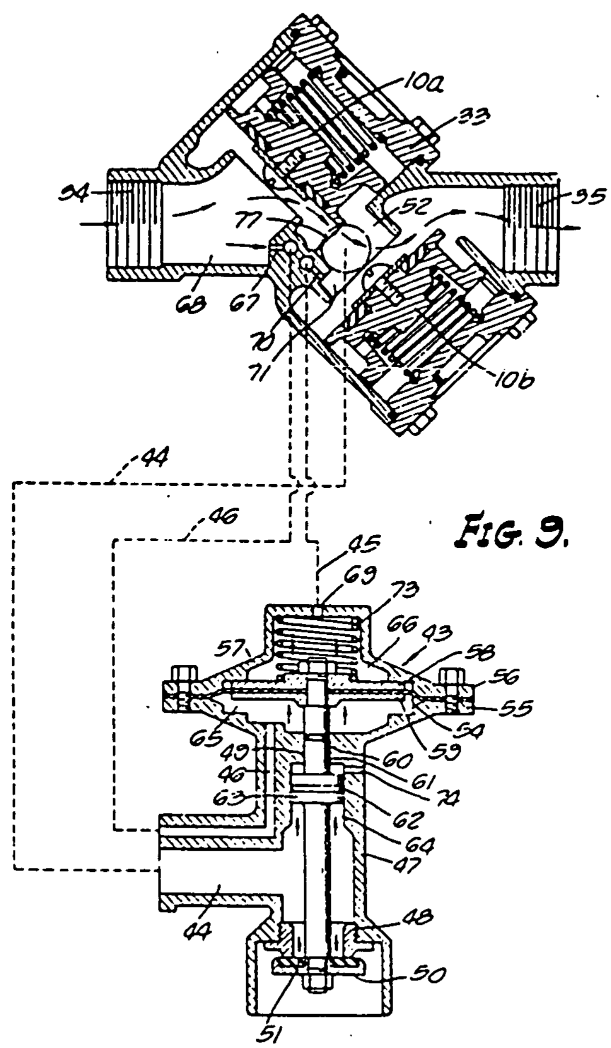

FIG. 9.

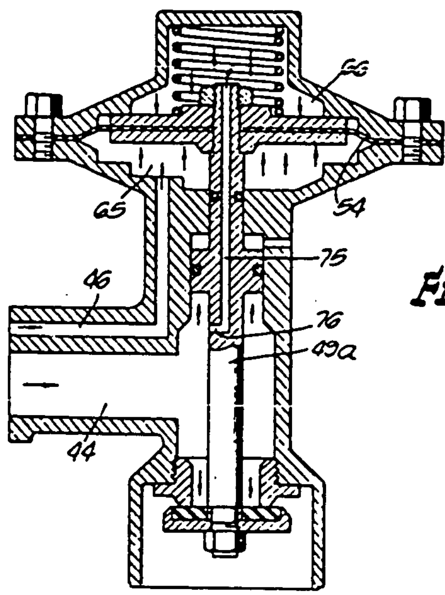

FIG. 11.

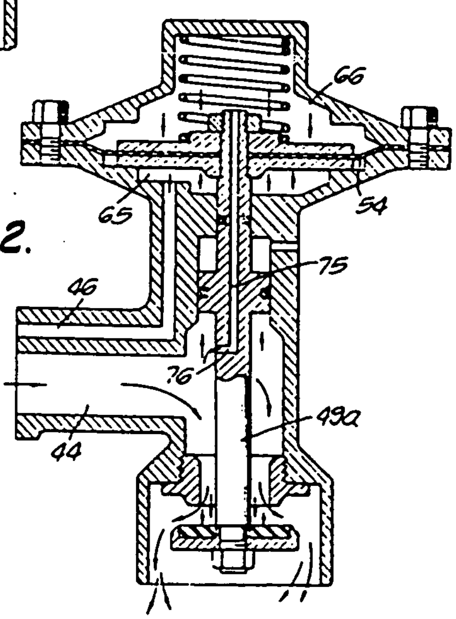

FIG. 12.

(12) UK Patent Application (19) GB (11) 2 104 195 A

(21) Application No 8216023
(22) Date of filing 22 Jun 1979
Date lodged
2 Jun 1982
(30) Priority data
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(32) 23 Jun 1978
(33) United States of America (US)
(43) Application published
2 Mar 1983
(51) INT CL³
F16K 15/02
(52) Domestic classification
F2V R4
U1S 1443 F2V
(56) Documents cited
None
(58) Field of search
F2V
(60) Derived from Application No. 8132470 under Section 15(4) of the Patents Act 1977

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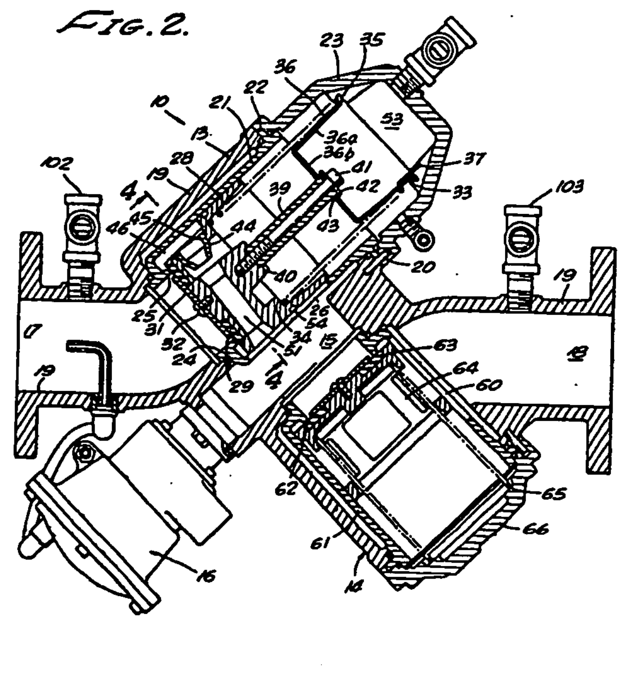
(54) **Check valve assembly**

(57) A check valve assembly comprising a stationary valve seat 25, a stationary barrel 21 positioned coaxially of said valve seat, a removable cover 23 secured relative to said barrel, a valve poppet 28 guided for movement in said barrel toward and away from said valve seat, a spring 33 acting to move said valve poppet into sealing contact with said valve seat, means cooperating with said barrel and said cover and said valve poppet to define a spring chamber 53 remote from said valve seat and enclosing said spring, said valve poppet having a central axial stem 39 fixed thereto, a spring retainer 36 positioned within a portion of said spring and having a central opening for sliding contact with said stem, said valve poppet, stem, spring and retainer being axially insertable into said barrel as a unitary assembly in the absence of said removable cover, and aspirator means 44 receiving fluid flow from said barrel when said valve poppet has separated from said valve seat, said aspirator means communicating with said spring chamber so that relatively rapid fluid flow through said aspirator means causes a reduction in fluid pressure in said spring chamber to oppose the action of said spring and thereby reduce the pressure drop across the check valve assembly.

FIG. 2.



GB 2 104 195 A

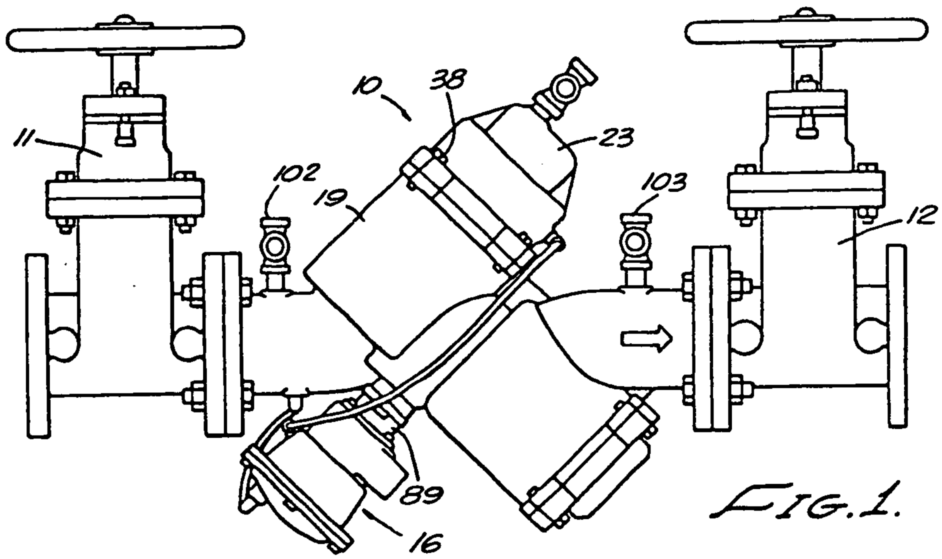

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FIG. 1.

FIG. 4.

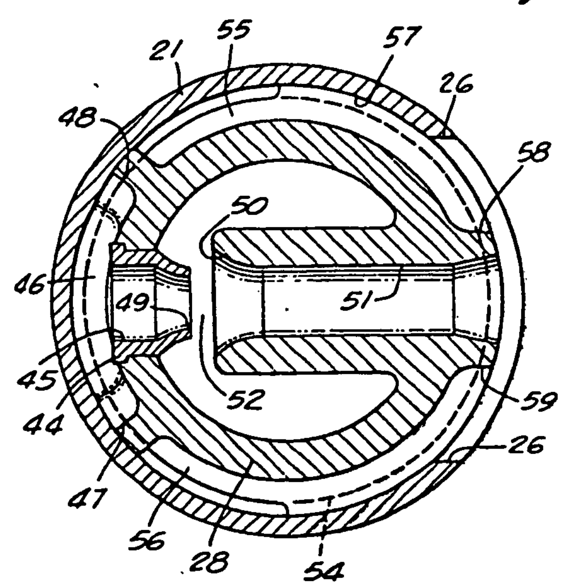
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FIG. 2.

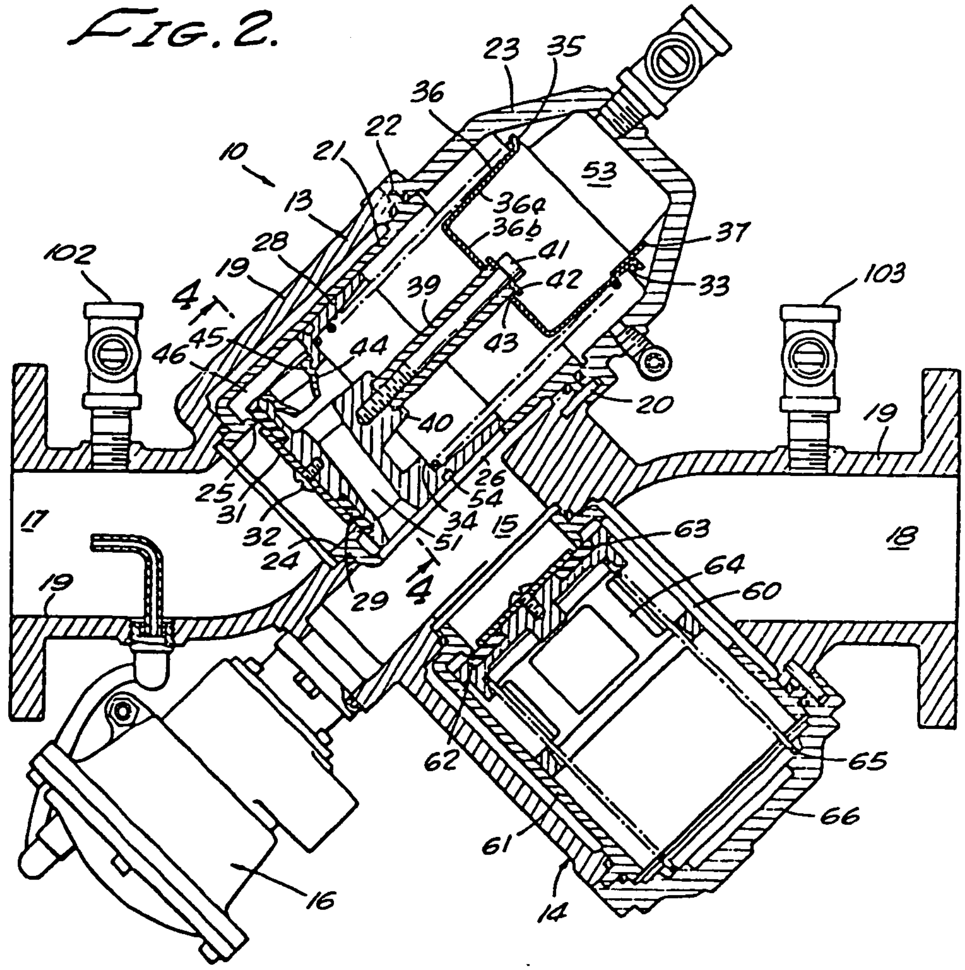
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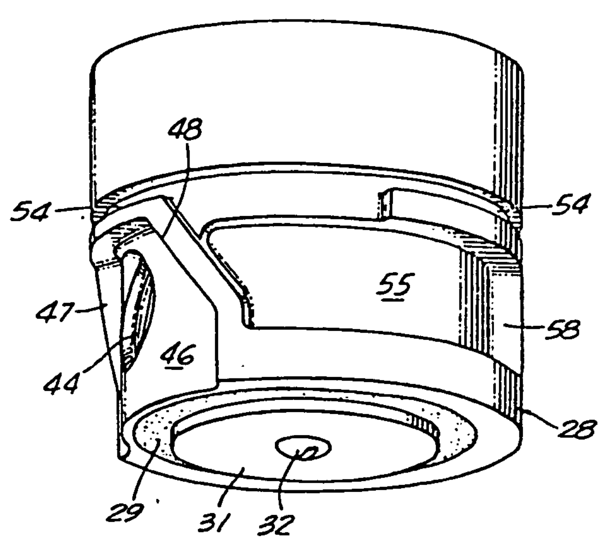
FIG. 3.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SPECIFICATION

Check valve assembly

This invention, whose subject matter has been divided from Patent Application No. 8132470, itself divided from Application No. 2023776, relates to a check valve assembly for use in backflow prevention apparatus to be installed between a supply pipe and a discharge pipe. Such devices are commonly used in water supply systems in order to insure that polluted water in a discharge pipe cannot flow in a reverse direction into a supply pipe.

According to the invention there is provided a check valve assembly comprising a stationary valve seat, a stationary barrel positoned coaxially of said valve seat, a removable cover secured relative to said barrel, a valve poppet guided for movement in said barrel toward and away from said valve seat, a spring acting to move said valve poppet into sealing contact with said valve seat, means cooperating with said barrel and said cover and said valve poppet to define a spring chamber remote from said valve seat and enclosing said spring, said valve poppet having a central axial stem fixed thereto, a spring retainer positioned within a portion of said spring and having a central opening for sliding contact with said stem, said valve poppet, stem, spring and retainer being axially insertable into said barrel as a unitary assembly in the absence of said removable cover, and aspirator means receiving fluid flow from said barrel when said valve poppet has separated from said valve seat, said aspirator means communicating with said spring chamber so that relatively rapid fluid flow through said aspirator means causes a reduction in fluid pressure in said spring chamber to oppose the action of said spring and thereby reduce the pressure drop across the check valve assembly.

An embodiment of the invention will now be described by way of example and with reference to the accompanying drawings, in which:—

Figure 1 is a side elevation showing backflow prevention apparatus incorporating a check valve according to this invention;

Figure 2 is a sectional elevation showing a portion of Figure 1;

Figure 3 is a perspective view showing the valve poppet employed in the upstream check valve assembly;

Figure 4 is a transverse sectional view of the valve poppet shown in Figure 3, taken substantially on the lines 4-4 as shown in Figure 2.

Referring to the drawings, the backflow prevention device generally designated 10 is positioned between two conventional gate valves 11 and 12. The gate valve 11 forms a part of a water supply pipe, and the gate valve 12 forms a part of a water discharge pipe. The device 10 prevents flow of water from the discharge pipe back into the supply pipe.

As shown in Figure 2, the device 10 includes an upstream check valve assembly generally designated 13 and embodying the present invention, and a downstream check valve assembly generally designated 14 having a zone 15 between them. A relief valve assembly generally designated 16 vents the zone 15 to atmosphere whenever the pressure in zone 15 and chamber 53 approaches the pressure in the inlet passage 17, within predetermined limits. The relief valve 16 is described in detail in the aforementioned Patent Application No. 2 023 776 and in Patent Application No. 8 132 471 which is another divisional of the same application. The passages 17 and 18 and the zone 15 are all formed within the integral body 19. The upstream check valve assembly 13 and the downstream check valve assembly 14 are mounted on the body 19 at right angles to each other, and each is positioned at an angle of 45 degrees to the aligned axes of the inlet and outlet passages 17 and 18.

The upstream check valve assembly 13 includes a stationary barrel 21 mounted within the body 19 and having a flange 22 clamped between the body 19 and the stationary cover 23. An alignment pin 20 assures the proper orientation of the barrel 21 within the body 19. One end of the barrel 21 has a circular opening 24 defined within a stationary annular seat 25. The barrel 21 has a side window 26 communicating with the zone 15.

A valve poppet 28 is slidably mounted in the barrel 21 for movement toward and away from the stationary seat 25. The valve poppet 28 is provided with an annular resilient disk 29 which cooperates with the seat 25 to form a bubble tight seal. A retainer plate 31 holds the resilient disk in position and is itself fixed to the valve poppet 28 by means of the screw 32. A coil compression spring 33 has one end seated against the internal shoulder 34 of the valve poppet 28 and the other end engaging an end flange 35 on the spring retainer 36. The spring 33 encircles the tapering portion 36a of the retainer. A key 37 prevents turning of the retainer within the cover 23, which cover is secured to the body 13 by means of threaded fastenings 38, as shown in Figure 1. A central non-circular tubular stem 39 is secured to the valve poppet 28 by means of the threaded element 41 and washer 42, and slides through a notching non-circular opening 43 in the radial portion 36b of the spring retainer 36. The stem 39 is received into a matching recess 40 in the valve poppet 28. The valve poppet 28, stem 39, element 41, washer 42, retainer 36 and spring 33 constitute a unitary assembly for installation into position, in the absence of the cover 23. For safety reasons a special tool is required to engage the threaded element 41. The assembly of cover 23 causes the spring to be further compressed beyond its relaxed position.

An ejector nozzle 44 is mounted on the valve poppet 28 and has a relatively large entrance opening 45 communicating with the space 46 defined between the valve poppet 28 and the barrel 21 and between the ribs 47 and 48. The discharge opening 49 is smaller and is directed toward a discharge passage 51 in the valve poppet 28 but which is separated therefrom by the space 52. The space 52 communicates with a reduced pressure chamber 53 containing the spring 33. This chamber 53 extends into the upper portion of the barrel 21 and into the cover 23 both inside and outside of the spring retainer 36.

A circumferential groove 54 is formed in the outer cylindrical surface of the valve poppet 28, and this

groove 54 is interrupted at two locations to communicate with the arcuate spaces 55 and 56 formed in the outer surface of the valve poppet 28 and bounded by the interior surface 57 of the stationary barrel 21. The arcuate space 55 extends from the rib 48 to the rib 58, and the arcuate space 56 extends from the rib 47 to the rib 59. Both of these arcuate spaces 55 and 56 communicate with the window opening 26 in the barrel 21. As best shown in Figure 4, the transverse passage 51 in the valve poppet 28 discharges through the center of the window opening 26 in the stationary barrel 21.

In the check valve 13 the space 46, the chamber 53 and the window 26 constitute respectively the first, second and third chambers referred to elsewhere in this specification.

The downstream check valve assembly 14 is similar to the upstream check valve assembly 13 in many respects except that it does not have an ejector nozzle 44 or a transverse passage 51. The stationary barrel 61 carries the stationary annular seat 62 which is engaged by the resilient disk 63 carried on the valve poppet 64. The coil compression spring 65 engages the cover 66 at one end and engages the valve poppet 64 at the other end. The cover 66 and the barrel 61 are secured to the body and aligned in the manner described in connection with the upstream check valve assembly 13.

In the operation of the backflow prevention device the pressume of water in the upstream gate valve 11 acts through the inlet passage 17 and against the exposed portion of the upstream check valve assembly 13 within the annular stationary seat 25. This pressure tends to open the valve in opposition to the force of the spring 33. When the upstream pressure has reached a sufficient intensity to move the valve disk 29 away from the seat 25, the pressure acts over a larger cross-sectional area of the valve poppet 28 and the additional force increases the opening movement of the valve disk 29 away from the stationary seat 25. Water flows into the arcuate space 46 between the shoulders 47 and 48 and passes through the ejector nozzle 44 and into the flared entrance opening 50 of the transverse passage 51. The rapid flow from the small discharge end of the ejector nozzle 44 reduces the pressure of liquid in the chamber 53 by an aspiration effect. Water is discharged from the transverse passage 51 through the zone 15 and its velocity head acts directly on the exposed surface of the valve poppet 64 in the downstream check valve assembly 14. Water is discharged through the window 60 in the wall of the barrel 61 and passes into the discharge passage 18 in the body 19.

The configuration of the ribs and spaces on the outer surface of the valve poppet 28 in the upstream check valve assembly 13 has the following beneficial effect: the flow from the inlet passage 17 is shielded from any substantial communication directly with the zone 15, and instead the flow from the inlet passage 17 is directed toward the arcuate space 46 which is defined between the inclined ribs 47 and 48 and which space 46 feeds the ejector nozzle 44. The spaces or pockets 55 and 56 on the other side of these barrel-containing ribs 47 and 48 are in direct open communication with the side window 26 in the stationary barrel 21, and hence are in communication with the zone 15. The circumferential cross flow on the periphery of the valve poppet 28 through the groove 54, pockets 55 and 56 and side window 26 serves as a barrier to leakage from the inlet 17 axially along the cylindrical surface of the valve poppet 28 into the aspirated chamber 53.

Check valve 13 is designed to maintain a specified minimum pressure differential and cooperates with the relief valve assembly 16 to insure that no reverse flow could ever occur. If for any reason the pressure differential reflected to the assembly falls below a prescribed level, the relief valve assembly will open and vent the zone 15 to atmosphere as a means of maintaining this required differential. The second check valve 14 normally will also maintain a lesser pressure differential; however, it is subject to system pressure conditions wherein the pressure in discharge chamber 18 can exceed the normal supply pressure in chamber 17. Under these conditions the function of check valve 14 is to remain closed and isolate zone 15 from the higher backflow pressures. If the second check valve 14 should leak, this reverse flow would tend to equalize the pressure differential maintained across the first check valve 13 and consequently the relief valve assembly 16 would be caused to open and vent the zone 15 to atmosphere and dissipate the reverse flow leakage, as particularly described in the aforementioned Patent Applications.

Check valve 13 functions to maintain a high initial pressure differential as a backflow protection margin of safety, and to resist initial flow through the check valve. However, as normal flow is established and increases, the initial pressure differential across its seat is reflected against the larger area of the valve poppet 28 and is applied across the ejector 44 which in turn aspirates the chamber 53. This combined effect causes the check valve 13 to provide a substantially reduced pressure differential under flowing conditions. This substantially reduced pressure differential is actually less than the initial pressure differential required under a no flow condition. The manner in which this lower than normal pressure differential is prevented from causing the differential relief valve 16 to open is fully described in the aforementioned Patent Applications.

The device shown in the drawings and described above has been found to have exceptional operating characteristics. The pressure required for initial opening of the upstream check valve 13 is relatively high, and yet the pressure drop from the inlet passage 17 to the outlet passage 18 is exceptionally low during normal flow conditions.

CLAIMS

1. A check valve assembly comprising a stationary valve seat, a stationary barrel positioned coaxially of said valve seat, a removable cover secured relative to said barrel, a valve poppet guided for movement in said barrel toward and away from said valve seat, a spring acting to move said valve poppet into sealing contact with said valve seat, means cooperating with said barrel and said cover and said valve poppet to define a spring chamber remote

from said valve seat and enclosing said spring, said valve poppet having a central axial stem fixed thereto, a spring retainer positioned within a portion of said spring and having a central opening for sliding contact with said stem, said valve poppet, stem, spring and retainer being axially insertable into said barrel as a unitary assembly in the absence of said removable cover, and aspirator means receiving fluid flow from said barrel when said valve poppet has separated from said valve seat, said aspirator means communicating with said spring chamber so that relatively rapid fluid flow through said aspirator means causes a reduction in fluid pressure in said spring chamber to oppose the action of said spring and thereby reduce the pressure drop across the check valve assembly.

2. A check valve assembly as claimed in claim 1, further comprising a stationary body, the said stationary barrel being positioned within the body and having said valve seat thereon, and the said valve poppet, stem, spring, retainer, barrel and seat being axially insertable into said body as said unitary assembly in the absence of said removable cover.

New claims or amendments to claims filed on 22 Oct. 1982.
Superseded claims 1

1. A check valve assembly comprising a stationary valve seat, a stationary barrel positioned coaxially of said valve seat, a removable cover secured relative to said barrel, a valve poppet guided for movement in said barrel toward and away from said valve seat, a spring acting to move said valve poppet into sealing contact with said valve seat, said barrel and said cover and said valve poppet defining a spring chamber remote from said valve seat and enclosing said spring, said valve poppet having a central axial stem fixed thereto, a spring retainer positioned within a portion of said spring and having a central opening for sliding contact with said stem, said valve poppet, stem, spring and retainer being axially insertable into said barrel as a unitary assembly in the absence of said removable cover, and aspirator means receiving fluid flow from said barrel when said valve poppet has separated from said valve seat, said aspirator means communicating with said spring chamber so that relatively rapid fluid flow through said aspirator means causes a reduction in fluid pressure in said spring chamber to oppose the action of said spring and thereby reduce the pressure drop across the check valve assembly.

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(43) Offenlegungstag: 30. 4. 75

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(32) (33) (31) 26. 10. 73 USA 410173

(54) Bezeichnung: Rückstromsicherung

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DT 24 50 465 A1

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2 HAMBURG 36
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23. Oktober 1974

Griswold Controls
124 East Dyer Road
Santa Ana, Kalif.
(V. St. v. A.)

RÜCKSTROMSICHERUNG

Für diese Anmeldung wird die Priorität aus der entsprechenden U. S. Patentanmeldung Ser. No. 410 173 vom 26. Oktober 1973 in Anspruch genommen.

Die Erfindung betrifft allgemein Rückstromsicherungen und insbesondere eine aus zwei Einwegventilen bestehende Rückstromsicherung.

Wenn ein Durchfluß nur in einer Richtung zugelassen werden soll, nicht jedoch in der entgegengesetzten Richtung, werden im allgemeinen sogenannte Rückschlag- oder Einwegventile vorgesehen. An einem einzigen Einwegventil kann es jedoch immer zu einem Leckfluß kommen, weshalb einzelne Einwegventile als Rückstromsicherung nicht in Frage kommen, wenn jeder auch noch so geringfügige Rückstrom einwandfrei unterbunden werden soll.

Rückstromsicherungen, welche der vorgenannten Bedingung genügen, bestehen beispielsweise aus zwei in Reihe geschalteten Einwegventilen mit einem zwischenliegenden "Bereich". Bei normalem Durchfluß in Vorwärtsrichtung durch die beiden Einwegventile sind beide geöffnet; wenn jedoch der Druck auf der Abstromseite sich dem auf der Aufstromseite herrschenden Druck bis auf einen innerhalb vorbestimmter Grenz-

werte von z.B. 0,14 at liegenden Druckwert nähert, wird der zwischen den beiden Einwegventilen befindliche Bereich zur freien Atmosphäre hin entlüftet. Folglich kann bei einer derartigen Rückstromsicherung der abstromseitige Druck auch unter Vakuumbedingungen nie höher ansteigen als der aufstromseitige Druck, was bedeutet, daß kein Rückstrom erfolgen kann.

Zur Rückstromsicherung dienende Vorrichtungen, hier kurz Rückstromsicherungen genannt, sind in der vorstehend beschriebenen Ausführung mit wenigstens zwei schwerwiegenden Nachteilen behaftet. Ein einwandfrei schließendes Einwegventil, das sich für bestimmte Anwendungen erst bei einem vorbestimmten Mindestdruck öffnet, arbeitet üblicherweise mit einer Federkraft, welche bei normalem Durchfluß durch das Einwegventil in Vorwärtsrichtung überkommen werden muß. Daher ergibt sich in vielen Fällen ein erheblicher Druckabfall, insbesondere bei Verwendung zweier in Reihe geschalteter Einwegventile. Ein weiterer Nachteil ist darin zu sehen, daß herkömmliche Vorrichtungen zur Entlüftung des zwischen den Einwegventilen befindlichen Bereichs normalerweise kostspielig, ungenau in der Wirkungsweise und nur schwierig zu warten sind.

Aufgabe der Erfindung ist daher die Schaffung einer Rückstromsicherung von einfachem Aufbau, welche einen verhältnismäßig hohen Anfangswiderstand gegenüber dem angelegten Druck und gegen Strömung aufweist, jedoch bei höherem Durchflußbedarf einen äußerst geringen Druckabfall bewirkt und selbsttätig einen vorbestimmten Differenzdruck zwischen der Abstrom- und der Aufstromseite aufrecht erhält.

Die zur Lösung der gestellten Aufgabe vorgeschlagene Rückstromsicherung besteht aus zwei Einwegventilen und ist erfindungsgemäß dadurch gekennzeichnet, daß jedes Einweg-

ventil einen Einlaßkanal, der in einen feststehenden Ringsitz für ein in einer koaxial zu dem Ringsitz ausgerichteten feststehenden Gleitbuchse zu dem Ringsitz hin und von diesem weg verstellbares Ventilglied ausläuft, welches vermittels einer Feder in abdichtende Anlage gegen den Ringsitz beaufschlagt und mit einem innerhalb der Gleitbuchse gleitend verschiebbar geführten Axialflansch versehen ist, sowie eine durch Gleitbuchse und Ve-ntilglied begrenzte, von dem Ringsitz entfernte Kammer und einen Auslaßkanal aufweist, der Flansch des Ventilglieds teilweise in den Auslaßkanal hineinragt und eine Verbindung zwischen dem Auslaßkanal und der Kammer herstellt, und bei Durchfluß durch das Einwegventil in Vorwärtsrichtung der in der Kammer herrschende Druck verringerbar und eine der Feder entgegengesetzt gerichtete Kraft erzeugbar ist.

Weitere Ausgestaltungen bilden den Gegenstand der Unteransprüche 2 - 18.

Die einzelnen Merkmale, sowie die Vorteile der Erfindung werden im nachfolgenden anhand der in den Zeichnungen dargestellten Ausführungsbeispiele näher erläutert.

Fig. 1 ist ein Aufrißquerschnitt durch eine bevorzugte Ausführungsform einer erfindungsgemäß ausgebildeten Rückstromsicherung in Form eines Einwegventils, dessen Einlaß- und Auslaßkanal koaxial zueinander ausgerichtet sind und wobei die Verstellachse des Ventilglieds einen Winkel von 45° mit Einlaß- und Auslaßkanal einschließt.

Fig. 2 ist ein Querschnitt durch ein Einwegventil, dessen Einlaß- und Auslaßkanal unter 90° zueinander ausgerichtet sind, wobei

die Verstellachse des Ventilglieds koaxial zu dem Einlaßkanal verläuft.

Fig. 3 ist ein Querschnitt durch eine weitere Ausführungsform, bei welcher Einlaß- und Auslaßkanal des Einwegventils koaxial zueinander ausgerichtet sind und die Verstellachse des Ventilglieds einen rechten Winkel mit beiden Kanälen einschließt.

Fig. 4 ist ein Querschnitt durch ein Einwegventil, bei dem Einlaß- und Auslaßkanal, sowie die Verstellachse des Ventilglieds sämtlich koaxial zueinander ausgerichtet sind.

Fig. 5 ist ein Schnitt durch eine bevorzugte Ausführungsform der Rückstromsicherung, wobei beide Einwegventile in der Schließstellung dargestellt sind.

Fig. 6 ist eine grafische Darstellung des Druckverlusts in Abhängigkeit von dem Durchsatz in einer handelsüblichen Ausführungsform der aus zwei Einwegventilen bestehenden Rückstromsicherung von Fig. 5. Die eine Kurve bezieht sich auf eine Rückstromsicherung von 19 mm Nennweite, und die andere auf eine solche von 25,4 mm Nennweite.

Fig. 7 ist eine Seitenansicht einer vollständigen Rückstromsicherung nach der Erfindung.

Fig. 8 ist eine endseitige Ansicht der Rückstromsicherung von Fig. 7.

Fig. 9 ist ein schematischer Aufrißquerschnitt durch eine aus zwei Einwegventilen und einem Differenzdruck-Steuerventil bestehende Rückstromsicherung und der Ver-

bindungen der Teile untereinander, wobei die Ventile in der Stellung für maximalen Durchsatz in Vorwärtsrichtung dargestellt sind.

Fig. 10 ist eine grafische Darstellung des Druckverlusts in Abhängigkeit von dem Durchsatz für die in den Fig. 7 - 9 dargestellte Rückstromsicherung, wobei die eine Kurve sich auf eine Vorrichtung mit der Nennweite 19 mm, und die andere auf eine solche mit der Nennweite 25,4 mm bezieht.

Fig. 11 ist ein Querschnitt durch eine abgeänderte Ausführungsform des Differenzdruck-Steuerventils, wobei die einzelnen Teile desselben in der Stellung für normalen Durchfluß in Vorwärtsrichtung dargestellt sind.

Fig. 12 ist eine Fig. 11 entsprechende Darstellung, wobei die Teile jedoch in einer einem Rückstromzustand entsprechenden Stellung dargestellt sind.

Verschiedene Ausführungsformen des in der Rückstromsicherung verwendeten Einwegventils sind in den Figuren 1, 2, 3 und 4 dargestellt. Das Einwegventil 10 weist ein innerhalb einer feststehenden Gleitbuchse 12 gleitend verschiebbar geführtes Ventilglied 11 auf. Ein elastischer Ring 13 bildet die Ventilsitzfläche und ist an dem Ventilglied 11 vermittels einer Haltescheibe 14 und einer Befestigungsschraube 15 befestigt. Eine auf das Ventilglied 11 einwirkende Schaubendruckfeder 17 beaufschlagt den Ventilkörper und damit den elastischen Ring 13 in abdichtenden Eingriff gegen einen feststehenden Ventil-Ringsitz 18, welcher am Ende des Einlaßkanals 19 ausgebildet ist.

Das Ventilglied 11 weist einen ersten Flansch 20 und einen zweiten Flansch 21 auf, wobei beide Flansche gleitend verschiebbar innerhalb der feststehenden Gleitbuchse 12 geführt sind. Eine zwischen den Flanschen 20 und 21 ausgebildete Ringnut 22 steht über eine oder mehrere Verbindungsöffnungen 23 in Verbindung mit der die Schraubendruckfeder 17 enthaltenden Federkammer 24. Bei der Ausführungsform nach Fig. 1 sind der Einlaßstutzen 26 und der Auslaßstutzen 27 koaxial zueinander angeordnet, und die Verstellachse des Ventilglieds 11 schließt einen Winkel von etwa 45° mit der Stutzenachse ein. Bei der Ausführungsform nach Fig. 2 steht der Einlaßstutzen 26a senkrecht zum Auslaßstutzen 27a, und die Verstellachse des Ventilglieds 11 verläuft koaxial zum Einlaßstutzen 26a. Bei der Ausführungsform nach Fig. 3 sind Einlaßstutzen 26b und Auslaßstutzen 27b koaxial zueinander ausgerichtet, während die Verstellachse des Ventilglieds 11 einen rechten Winkel mit dieser einschließt. Bei der Ausführungsform nach Fig. 4 sind Einlaßstutzen 26c und Auslaßstutzen 27c koaxial zueinander ausgerichtet, und die Verstellachse des Ventilglieds 11 fällt mit der Stutzenachse zusammen.

In den Figuren 1 - 4 ist das Einwegventil 10 in der Öffnungsstellung dargestellt, in welcher in den Einlaßkanal 19 eintretendes flüssiges oder gasförmiges Strömungsmittel zwischen dem Ringsitz 18 und dem elastischen Ring 13 hindurch in den Auslaßkanal 28 gelangt. Der dann in der Kammer 29 herrschende einlaßseitige Druck wirkt dann auf die gesamte beaufschlagbare Fläche des Flanschs 20 ein und ist somit der Kraft der Feder 17 entgegengesetzt gerichtet. Flansch 20 dient dabei zur Abdichtung zwischen dem Druckbereich in der Kammer 29 und dem Druckbereich in der Ringnut 22. Bei der Ausführungsform nach Fig. 4 umgibt das feststehende Gehäuse 30 die Gleitbuchse 12 und Axialkanäle 31, welche als Durchlässe für das Strömungsmittel von der

Kammer 29 zum Auslaßstutzen 27c vorgesehen sind.

In jedem Falle sind die Außendurchmesser der Flansche 20 und 21 des Ventilglieds 11 wesentlich größer als der wirksame Durchmesser des feststehenden Ringsitzes 18, so daß in der Schließstellung des Einwegventils, in welcher der elastische Ring 13 gegen den Ringsitz 18 anliegt, der im Einlaßkanal 19 herrschende Druck auf eine wesentlich kleinere Fläche einwirkt als der in der Federkammer 24 herrschende Druck. Sobald der im Einlaß-kanal 19 auf die Fläche des Ringsitzes 18 einwirkende Druck ausreichend hoch ist, um die Kraft der Schraubendruckfeder 17 und den in der Federkammer 24 herrschenden Druck zu überkommen, können statischer und dynamischer Druck unmittelbar auf die größere wirksame Fläche des Flanschs 20 einwirken. Aufgrund der Zunahme der Wirkfläche beim Öffnen des Ventils ergibt sich eine hohe, der Feder entgegengesetzt gerichtete Kraft, vermittels welcher der Ventilkörper mühelos in die Öffnungsstellung verstellt wird.

Wenn sich der Ventilkörper des Einwegventils in der Öffnungsstellung für Durchfluß in Vorwärtsrichtung entsprechend der Darstellung in den Figuren 1 - 4 befindet, wird durch den Strömungsmitteldurchfluß in der das Ventilglied 11 umgebenden Ringnut 22 ein Unterdruckbereich erzeugt, was darauf zurückzuführen ist, daß der Flansch 20 und die Ringnut 22 teilweise in den Auslaßkanal 28 hinein vorstehen. Dieser Unterdruck überträgt sich von der Ringnut 22 durch eine oder mehrere Verbindungsöffnungen 23 und durch den Zwischenraum zwischen dem Flansch 21 und der Gleitbuchse 12 zur Federkammer 24. Mit zunehmender Strömungsgeschwindigkeit in Vorwärtsrichtung nimmt daher der in der Kammer 24 herrschende Flächendruck im Vergleich zu dem auf die durch den Durchmesser des Flanschs 20 vorgegebene Wirkfläche einwirkenden Druck ab.

Wenn der Druck im Auslaßkanal 28 einen vorbestimmten Druckwert im Vergleich zu dem im Einlaßkanal 19 herrschenden Druck unterschreitet, stehen der in den Auslaßkanal 28 hineinragende Abschnitt des Ventilglieds 11 (siehe Fig. 1 - 3) und bei der Ausführungsform nach Fig. 4 das gesamte Ventilglied 11 unter dem vollen statischen und dynamischen Strömungsmitteldruck in Gegenrichtung, wobei die dadurch erzeugte Kraft auf die volle Wirkfläche der Federkammer 24 einwirkt und das Ventil unterstützt durch die Kraft der Feder 17 sofort schließt.

Wenn bei der beschriebenen Vorrichtung die Strömungsgeschwindigkeit in Vorwärtsrichtung zunimmt, bewirkt der Strömungsdruck eine positive Öffnungskraft auf das Ventilglied 11 an der den elastischen Ring 13 tragenden Seite, in Verbindung mit einer Absenkung des Flächendrucks innerhalb der Kammer 24, wobei beide Wirkungen gemeinsam eine der Feder 17 entgegengesetzte Kraft erzeugen. Die Druckabsenkung in der Federkammer beruht darauf, daß der Ventilgliedflansch 20 teilweise in den Auslaßkanal 28 hinein vorsteht und in diesem eine Einschnürung 77 ausbildet, so daß das Trägheitsmoment der Strömung, welches auf das in der Ringnut 22 stehende Strömungsmittel einwirkt, zu einer Druckabsenkung in der Ringnut 22 führt, welche wiederum durch die Verbindungsöffnung(en) 23 zur Federkammer 24 übertragen wird. Bei höherem Durchflußbedarf bewirkt folglich das entsprechend gesteigerte Trägheitsmoment eine Druckabnahme in der Federkammer. Mit zunehmendem Durchsatz nimmt auch der auf die volle Wirkfläche des Flanschs 20 (auf der Seite des elastischen Rings 13) einwirkende dynamische Druck zu. Da sich beide Wirkungen überlagern, bildet sich am Flansch 20 ein hohes Druckdifferential aus, das eine zunehmend höhere, der Feder 17 entgegengesetzte Kraft erzeugt. Trotz der Einschnürung 77 und eines durch diese erzeugten "induzierten" Druckabfalls an dieser Stelle

ergeben sich insgesamt gesehen ein vorteilhaftes Druckdifferential an dem Ventilglied 11, sowie eine Verringerung des Gesamtdruckabfalls im Ventil. Das Ventilglied 11 ist vermittels der in einem gegenseitigen Abstand angeordneten Flansche 20 und 21 unter Belassung eines ausreichend großen Spiels in der Gleitbuchse 12 hin und her gleitend verschiebbar geführt, wobei die Toleranzen ausreichend groß bemessen sind, um mechanische Reibungsverluste und mechanische Betriebsstörungen zu vermeiden. Da keine Führungsstifte, Hebel usw. vorhanden sind, ist die mechanische Reibung äußerst niedrig.

Bei dem in Fig. 5 dargestellten Doppel-Einwegventil 33 werden zwei Einwegventile 10a und 10b verwendet, welche im wesentlichen baugleich sind mit dem vorstehend beschriebenen Einwegventil 10. Die beiden Einwegventile 10a und 10b sind unter einem rechten Winkel zueinander angeordnet, wobei das Einwegventil 10a unter einem Winkel von 45° zur Achse des Einlaßstutzens oder -kanals 34, und das Einwegventil 10b unter einem Winkel von 45° zur Achse des Auslaßstutzens oder -kanals 35 ausgerichtet ist. Aufbau und Arbeitsweise der beiden Einwegventile 10a und 10b entsprechen denen des Einwegventils 10. Aufgrund der geometrischen Zuordnung der beiden Einwegventile 10a und 10b entsprechend Fig. 5 wird ein gleichförmiges Strömungsverhalten erzielt, indem Strömungsrichtungsänderungen und Hindernisse für Durchfluß in Vorwärtsrichtung weitgehend vermieden werden, wodurch wiederum der Druckabfall gering gehalten wird.

Die grafische Darstellung von Fig. 6 zeigt den Druckabfall durch die in Fig. 5 dargestellte Rückstromsicherung für eine Ausführung der Nennweite 19 mm (3/4 Zoll) und eine solche der Nennweite 25,4 mm (1 Zoll). Der Druckabfall durch die beiden Einwegventile 10a und 10b nimmt mit steigendem Durchsatz für die Ausführung von 19 mm Nennweite

bis zu etwa 3,39 m³/h (in der grafischen Darstellung 15 Skalenteile; 1 Skalenteil = 0,2263 m³/h entsprechend 1 Gallone pro Minute), und für die Ausführung von 25,4 mm Nennweite bis zu etwa 4,07 m³/h (18 Skalenteile) zu.

Die beweglichen Teile beider Einwegventile 10a und 10b lassen sich unabhängig voneinander ein- und ausbauen, wobei auch nicht erforderlich ist, die ganze Rückstromsicherung auszubauen. Außerdem sind beide Einwegventile so ausgelegt, daß sie bei Durchsatz in Vorwärtsrichtung mit dem vollen dynamischen Druck der Speiseleitung beaufschlagt werden, so daß hydraulische Druckverluste wirksam verringert sind. In jedem Einwegventil ragt ein Abschnitt des Ventilglieds in den zugeordneten Auslaßkanal hinein bzw. steht in Verbindung mit dem Auslaßkanal und ist somit ansprechbar auf den geringsten Rückstrom, um das Ventil unverzüglich zu schließen und einen Rückstrom zu verhindern.

Die in den Figuren 7, 8 und 9 dargestellte Rückstromsicherung weist ein Doppel-Einwegventil 33 auf, dessen Einlaßkanal 34 über einen Absperrschieber 37 und eine Rohrkupplung 38 mit einem Zuleitungsrohr 36 verbunden ist. Der Auslaßkanal 35 des Doppel-Einwegventils 33 ist über eine Rohrkupplung 39 und einen Absperrschieber 40 mit dem Anschlußrohr 41 verbunden.

Ein Steuerventil 43 ist mit dem Doppel-Einwegventil 33 durch eine Ablaßleitung 44 und die Druckfühlleitungen 45 und 46 verbunden. Die Ablaßleitung 44 bildet einen Teil des feststehenden Gehäuses 47, welches einen abnehmbaren Ventilsitz 48 enthält. Der Ventilschaft 49 trägt an seinem unteren Ende einen Ventilteller 50 mit einer elastischen Scheibe 51, welche zur abdichtenden Anlage gegen den Ventilsitz 48 bringbar ist. Wenn sich diese Teile in der in Fig. 9 dargestellten Stellung befinden, ist das Ventil

geschlossen, so daß kein Strömungsmittel aus dem Durchlaß 52 im Doppel-Einwegventil 33 durch die Ablaßleitung 44 hindurch abgegeben werden kann. Der Durchlaß 52 befindet sich auf der Abstromseite des Einwegventils 10a und auf der Aufstromseite des Einwegventils 10b.

Zur Verlagerung des Ventilschafts 49 in die Öffnungs- oder Schließstellung des Steuerventils 43 ist eine flexible Membran 54 vorgesehen, welche an ihrem äußeren Umfang zwischen dem Flansch 55 des Gehäuses und dem Flansch 56 an dem Deckel 57 eingespannt ist. Ein mittiger Abschnitt der Membran 54 ist zwischen den Platten 58 und 59 fest mit dem Ventilschaft 49 verbunden. Ein ebenfalls fest mit dem Ventilschaft 49 verbundener Dichtring 60 ist innerhalb der Gehäusebohrung 61 gleitend verschiebbar geführt, und ein Dichtring 62 auf dem Ringkolben 63 des Ventilschafts 49 ist innerhalb der Gehäusebohrung 64 gleitend verschiebbar geführt.

Innerhalb des Gehäuses 47 ist unterhalb der Membran 54 eine Kammer 65, und oberhalb der Membran innerhalb des Deckels 57 eine Kammer 66 ausgebildet. Die Gehäusekammer 65 steht über die Leitung 46 und die Öffnung 77 mit dem Einlaßkanal 68 des Einwegventils 10a in Verbindung. Die Deckelkammer 66 steht durch die Deckelöffnung 69, die Leitung 45 und die Öffnung 70 mit dem Einlaßkanal 71 des Einwegventils 10b in Verbindung. Somit ist ersichtlich, daß ein auf die Membran 54 einwirkender Differentialdruck dem Differentialdruck zwischen dem Einlaßkanal 68 und dem Einlaßkanal 71 entspricht.

Die in der Kammer 66 befindliche Schraubendruckfeder 73 beaufschlagt die Membranplatte 78 und damit den Ventilschaft 49 in Öffnungsrichtung des Ablaßventilteils 48, 50. Diese Federkraft wird unterstützt durch den Flächendruck in der Deckelkammer 66, wobei der in der Gehäusekammer 65 herrschende Flächendruck dieser Kraft entgegengesetzt gerichtet

ist. Diese Gegenkraft wird verstärkt durch den gegen die Unterseite des Ringkolbens 64 einwirkenden Strömungsmitteldruck. Der innerhalb des Gehäuses 47 oberhalb des Ringkolbens 63 befindliche Ringraum wird durch die Entlüftungsöffnung 74 zur freien Atmosphäre hin entlüftet.

Im Betrieb dient das Differenzdruck-Steuerventil 43 zur Entlüftung des zwischen den Einwegventilen 10a und 10b befindlichen Bereichs durch die Öffnung am Durchlaß 52, wenn der abstromseitige Druck sich dem aufstromseitigen Druck bis auf einen vorbestimmten Wert nähert. Die Teile können so ausgelegt und justiert sein, daß für einen Druck im Einlaßkanal 34, der um weniger als 0,14 at höher ist als der Druck im Auslaßkanal 35, das Differenzdruck-Steuerventil 43 geöffnet wird und eine Entlüftung von Strömungsmittel durch die am Durchlaß 52 befindliche Öffnung und durch die Ablaßleitung 44 und den nunmehr offen stehenden Teil 48, 50 des Steuerventils 43 hindurch zur freien Atmosphäre gestattet. Die außer der Schwerkraft (Eigengewicht) auf den Ventilschaft einwirkenden Kräfte sind die sich entgegengesetzt gerichteten Kräfte aufgrund des in der Gehäusekammer 65 herrschenden Einlaßdrucks, des in der Deckelkammer 66 herrschenden Auslaßdrucks, des Drucks im Durchlaßbereich 52, welcher am Ringkolben 63 und am Ventilteller 50 anliegt, und schließlich die Kraft der Feder 73.

Dabei ist zu beachten, daß die Wirkfläche der Membran 54 wesentlich größer ist als die des Ventilsitzes 48. Weiterhin sind die Öffnungen 67 und 70 unter einem Winkel derart zueinander angeordnet, daß sie sowohl den statischen als auch den dynamischen Druck im entsprechenden Durchlaß aufnehmen. Das Differenzdruck-Steuerventil 43 entlüftet daher immer dann Strömungsmittel durch die am Durchlaß 52 befindliche Öffnung, wenn der im Auslaßkanal des Einwegventils 10a herrschende (und über die Druckfühlleitung 45

übertragene) Druck zusätzlich der Federkraft 76 und zusätzlich der Schwerkraft höher ist als der (durch die Druckfühlleitung 46 übertragene) Druck im Einlaßkanal 68, welcher an der Gehäusekammer 65 anliegt. Die Wirkfläche des zum Ausgleich dienenden Ringkolbens 63 ist gleich der des Ventilsitzes 48 in Verbindung mit der des Ventilschafts 49, so daß der auf den Ventilteller 50 und den Ventilschaft 49 einwirkende Druck durch den auf den Ringkolben 63 einwirkenden Druck aufgehoben wird. In entsprechender Weise bleibt das Differenzdruck-Steuerventil 43 geschlossen und läßt kein Strömungsmittel durch die am Durchlaß 52 befindliche Öffnung austreten, wenn die durch den Einlaßdruck in der Gehäusekammer 65 erzeugte Gesamtkraft größer ist als die Summe der durch den Auslaßdruck in der Deckelkammer 66, die Federkraft 73 und die Schwerkraft erzeugten Kräfte.

Die grafische Darstellung von Fig. 10 zeigt den Verlauf des Druckverlusts in der Rückstromsicherung der Fig. 7 und 8 für die Nennweiten von 19 mm und 25,4 mm bei normalem Durchsatz in Vorwärtsrichtung. Es läßt sich ersehen, daß der Druckverlust durch die Rückstromsicherung abnimmt, und zwar bei 19 mm Nennweite bis zu etwa 4,5 m^3/h (20 Skalenteile), und bei 25,4 mm Nennweite bis zu etwa 7,2 m^3/h (32 Skalenteile).

Bei der in den Figuren 11 und 12 dargestellten abgeänderten Ausführungsform des Differenzdruck-Steuerventils ist die Deckelöffnung 69 durch einen Axialkanal 75 im Ventilschaft 49a ersetzt. Dieser Axialkanal 75 verbindet über eine seitliche Auslaßöffnung 76 die Deckelkammer 66 mit der Ablaßleitung 44. Es wird nur eine einzige Druckfühlleitung 46 verwendet, welche die Gehäusekammer 65 in der vorstehend beschriebenen Weise mit dem Einlaßkanal 68 verbindet. Die Druckfühlleitung 45 und die Öffnung 70 werden nicht benutzt.

Figur 11 zeigt die Teile des Differenzdruck-Steuerventils in der Schließstellung, welche dem normalen Durchsatz in Vorwärtsrichtung entspricht. Fig. 12 zeigt die gleichen Teile in der Stellung, in welcher Strömungsmittel von der Öffnung am Durchlaß 52 bei vorhandenem oder einsetzendem Rückstrom zur freien Atmosphäre abgegeben wird. Ansonsten entsprechen der Aufbau und die Arbeitsweise des abgeänderten Differenzdruck-Steuerventils nach den Fig. 11 und 12 denen des vorstehend beschriebenen Steuerventils.

- Patentansprüche: -

Patentansprüche:

1. Rückstromsicherung aus zwei Einwegventilen, dadurch gekennzeichnet, daß jedes Einwegventil (10) einen Einlaßkanal (19), der in einen feststehenden Ringsitz (18) für ein in einer koaxial zu dem Ringsitz ausgerichteten feststehenden Gleitbuchse (11) zu dem Ringsitz hin und von diesem weg verstellbares Ventilglied (11) ausläuft, welches vermittels einer Feder (17) in abdichtende Anlage gegen den Ringsitz beaufschlagt und mit einem innerhalb der Gleitbuchse (12) gleitend verschiebbar geführten Axialflansch (20) versehen ist, sowie eine durch Gleitbuchse und Ventilglied begrenzte, von dem Ringsitz entfernte Kammer (24) und einen Auslaßkanal (28) aufweist, der Flansch des Ventilglieds teilweise in den Auslaßkanal hineinragt und eine Verbindung zwischen dem Auslaßkanal und der Kammer herstellt, und bei Durchfluß durch das Einwegventil (10) in Vorwärtsrichtung der in der Kammer herrschende Druck verringerbar und eine der Feder (17) entgegengesetzt gerichtete Kraft erzeugbar ist.

2. Rückstromsicherung nach Anspruch 1, dadurch gekennzeichnet, daß die Gleitbuchse (12) koaxial zu dem Ringsitz (18) angeordnet ist und größere Abmessungen als dieser aufweist.

3. Rückstromsicherung nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß die Feder aus einer innerhalb der Kammer (24) angeordneten Schraubendruckfeder (17) besteht.

4. Rückstromsicherung nach einem der Ansprüche 1 - 3, dadurch gekennzeichnet, daß der Einlaßkanal (15) mit einem Einlaßstutzen (26), und der Auslaßkanal (28) mit einem Auslaßstutzen (27) versehen ist.

5. Rückstromsicherung nach Anspruch 4, dadurch gekennzeichnet, daß Einlaß- und Auslaßstutzen (26 bzw. 27) axial zueinander ausgerichtet sind.

6. Rückstromsicherung nach Anspruch 5, dadurch gekennzeichnet, daß die Achse, in welcher das Ventilglied (11) verstellbar ist, senkrecht zu Einlaß- und Auslaßstutzen ausgerichtet ist.

7. Rückstromsicherung nach Anspruch 4 oder 5, dadurch gekennzeichnet, daß die Achse, in welcher das Ventilglied (11) verstellbar ist, unter einem Winkel von etwa 45° zu Einlaß- und Auslaßstutzen ausgerichtet ist.

8. Rückstromsicherung nach Anspruch 4, dadurch gekennzeichnet, daß Einlaß- und Auslaßstutzen (26 bzw. 27) und die Achse, in welcher das Ventilglied (11) verstellbar ist, axial zueinander ausgerichtet sind.

9. Rückstromsicherung nach Anspruch 4, dadurch gekennzeichnet, daß Einlaß- und Auslaßstutzen (26 bzw. 27) unter einem rechten Winkel zueinander ausgerichtet sind, und die Achse, in welcher das Ventilglied (11) verstellbar ist, koaxial zum Einlaßstutzen angeordnet ist.

10. Rückstromsicherung nach Anspruch 1, wobei zwei Einwegventile nach einem oder mehreren der Ansprüche 1 - 9 hintereinandergeschaltet sind, d a d u r c h g e k e n n z e i c h n e t, daß der Auslaßkanal des ersten Einwegventils (10a) den Einlaßkanal für das zweite Einwegventil (10b) bildet.

11. Rückstromsicherung nach Anspruch 10, dadurch gekennzeichnet, daß der Einlaßkanal (34) des ersten Einwegventils (10a) mit dem Auslaßkanal (35) des zweiten Einwegventils (10b) axial ausgerichtet ist und die

Achse der Ventilglieder jeweils unter einem Winkel von etwa 45° zu dem Einlaßkanal und dem Auslaßkanal und unter einem rechten Winkel zueinander ausgerichtet sind.

12. Rückstromsicherung nach einem der Ansprüche 1 - 9, dadurch gekennzeichnet, daß das Ventilglied (11) zwei in der Gleitbuchse (12) in gegenseitigem Axialabstand gleitend verschiebbar geführte Flansche (20, 21) aufweist, welche zwischen sich eine Ringnut (22) bilden, wobei wenigstens ein Flansch teilweise in den Auslaßkanal hineinragt und eine Verbindung zwischen dem Auslaßkanal (28) und der Ringnut herstellt, und die Ringnut durch eine oder mehrere Öffnungen (23) mit der von dem Ringsitz (18) entfernten Kammer (24) verbunden ist.

13. Rückstromsicherung nach Anspruch 10, dadurch gekennzeichnet, daß bei beiden Einwegventilen das verstellbare Ventilglied (11) gleitend verschiebbar innerhalb der koaxial zu dem Ventil-Ringsitz (18) ausgerichteten und größere Abmessungen als der Ringsitz aufweisenden Gleitbuchse (12) geführt und die das Ventilglied beaufschlagende Feder (17) in die von Gleitbuchse und Ventilglied gebildete Kammer (24) eingesetzt, der Bereich (52) zwischen den beiden hintereinandergeschalteten Einwegventilen über ein Steuerventil (43) zur freien Atmosphäre entlüftbar und das Steuerventil auf einen am aufstromseitigen Einwegventil (10b) herrschenden Druckunterschied ansprechbar ausgebildet ist.

14. Rückstromsicherung nach Anspruch 12 oder 13, dadurch gekennzeichnet, daß die Ringnut (22) jedes Ventilglieds (11) durch eine Öffnung (23) mit der im Ventil ausgebildeten Kammer (24) in Verbindung steht.

15. Rückstromsicherung nach Anspruch 14, dadurch gekennzeichnet, daß das Steuerventil (43) eine durch stati-

schen und dynamischen Druck im Einlaßkanal des aufstromseitigen Einwegventils (10b) beaufschlagbare erste Öffnung und eine auf durch wesentlich verringerten Druck im Auslaßkanal (35) desselben Einwegventils beaufschlagbare zweite Öffnung (69) aufweist.

16. Rückstromsicherung nach einem der Ansprüche 13 - 15, dadurch gekennzeichnet, daß das auf Differenzdruck ansprechbare Steuerventil (43) aus einem Gehäuse (47) mit einem Ventilsitz (48), einem axial in dem Gehäuse verschiebbaren Ventilglied mit einem Ventilschaft (49) und einem in abdichtende Anlage gegen den Ventilsitz bringbaren Ventilteller (50), einem Deckel (57), einer flexiblen Membran (54), die an ihrem Umfang zwischen dem Deckel und dem Gehäuse eingespannt ist und eine Kammer (65) innerhalb des Gehäuses, sowie eine Kammer (66) innerhalb des Deckels ausbildet, einer Verbindung zwischen der Membran und dem Ventilschaft und einer in der Deckelkammer (66) angeordneten und den Ventilschaft in Öffnungsrichtung beaufschlagenden Feder (73) besteht, der zwischen den beiden hintereinandergeschalteten Einwegventilen (10a, 10b) gebildete Durchlaßbereich (52) über eine Abgabeöffnung mit dem Steuerventilgehäuse (47) verbunden ist, die Gehäusekammer (65) über eine Druckfühlleitung (46) mit der Aufstromseite des aufstromseitigen Einwegventils (10b), und die Deckelkammer (66) über eine weitere Druckfühlleitung (45) mit der Abstromseite des Einwegventils verbunden ist und ein fest auf dem Ventilschaft (49) angeordneter, innerhalb des Gehäuses gleitend verschiebbar geführter und zum Druckausgleich dienender Ringkolben (63) dazu dient, eine Gegenkraft gegen die von der Abgabeöffnung übermittelte und den Ventilteller (50) im Abhebesinn von dem Ventilsitz (48) weg beaufschlagende Strömungsdruckkraft zu erzeugen.

17. Rückstromsicherung nach Anspruch 16, dadurch gekennzeichnet, daß die Druckfühlleitungen (45, 46) jeweils in eine durch statischen und dynamischen Druck beaufschlagbare Öffnung (70 bzw. 67) münden, wobei die aufstromseitige Öffnung (67) durch einen wesentlich höheren Gesamtdruck als die abstromseitige Öffnung (70) beaufschlagbar ist.

18. Rückstromsicherung nach Anspruch 16, dadurch gekennzeichnet, daß die Deckelkammer (66) nicht mit der Aufstromseite des Einwegventils, sondern vermittels eines im Ventilschaft (49) ausgebildeten Axialkanals (75) mit dem Innenraum des Ventilgehäuses (47) verbunden ist.

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Leerseite

G. 74 106
Griswold Controls

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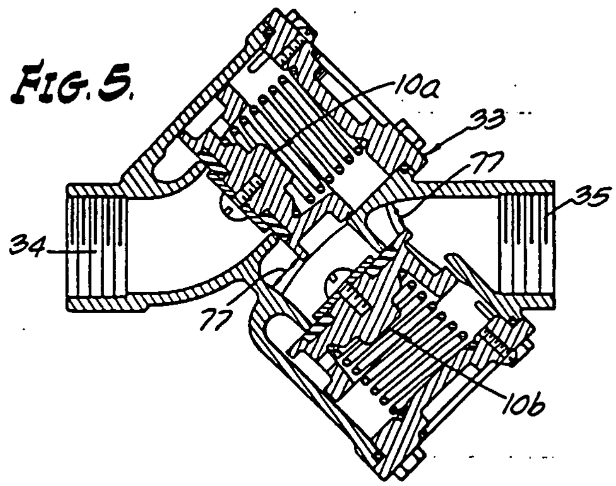

FIG. 5.

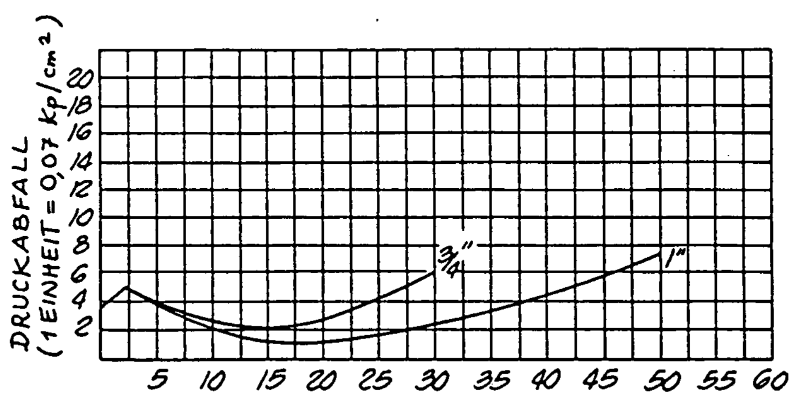

FIG. 6. (1 EINHEIT = 0,2263 m^3/h)

= 1 gpm

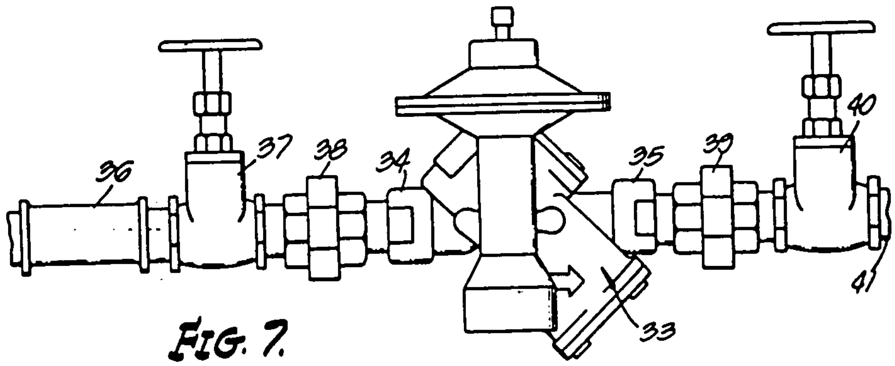

FIG. 7.

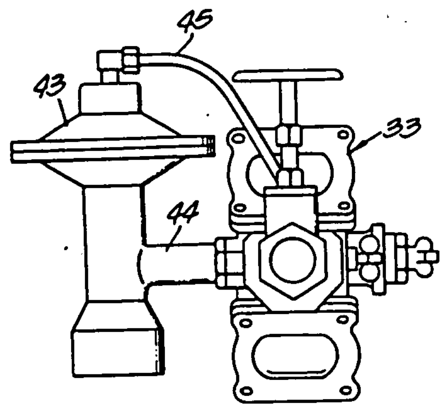

FIG. 8.

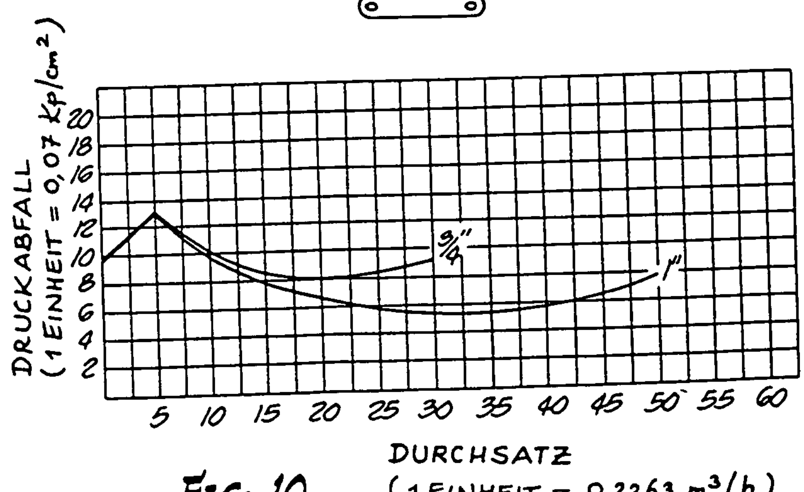

FIG. 10.

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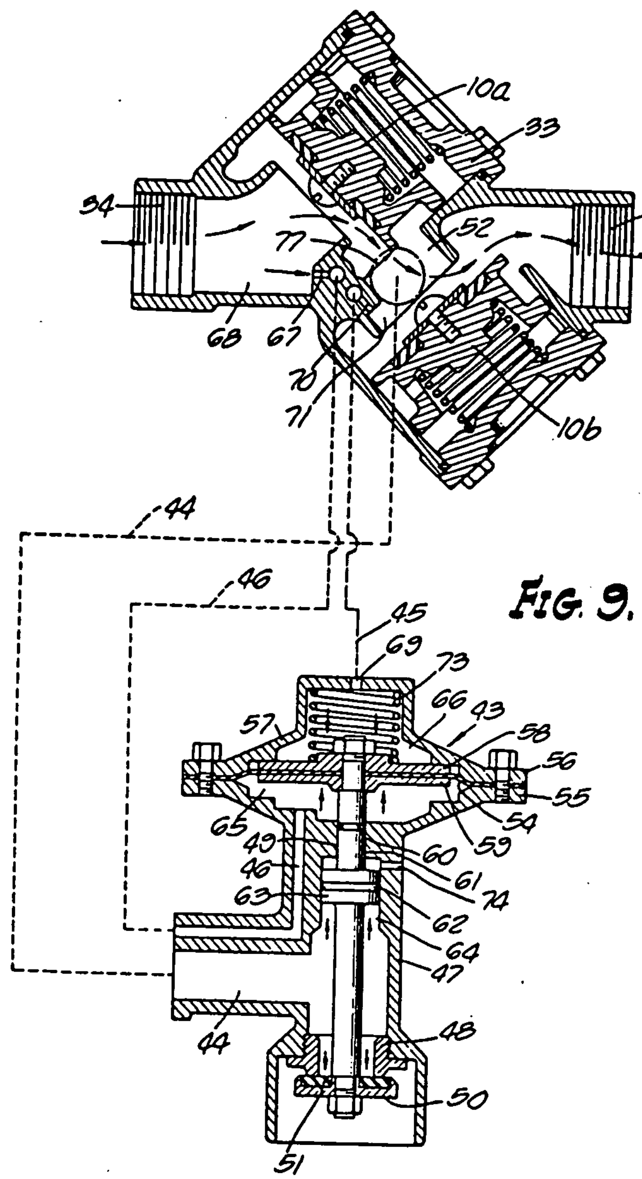

FIG. 9.

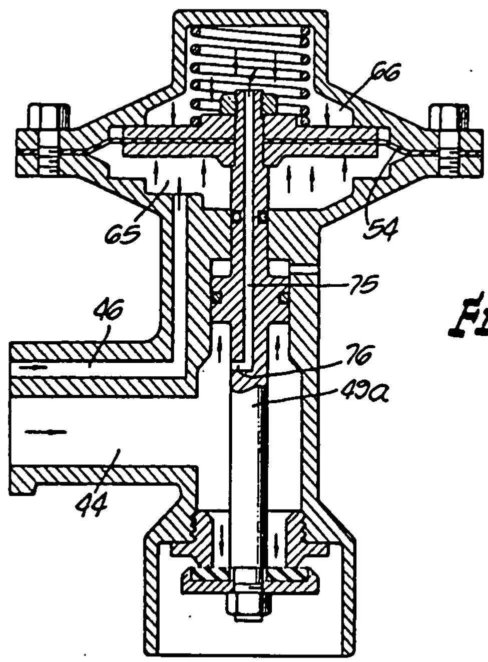

FIG. 11.

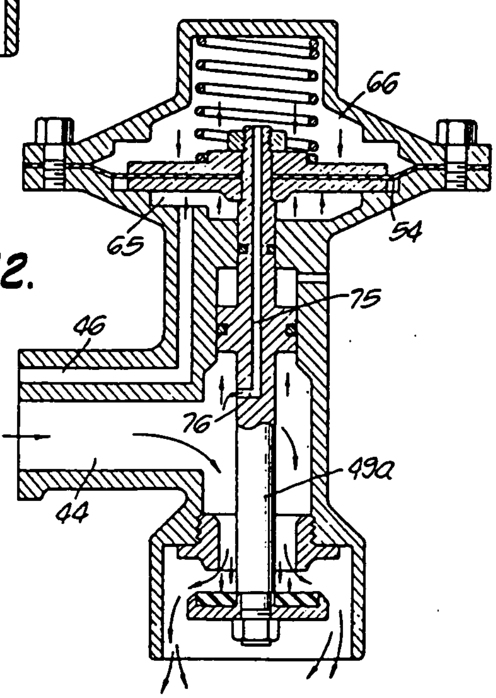

FIG. 12.

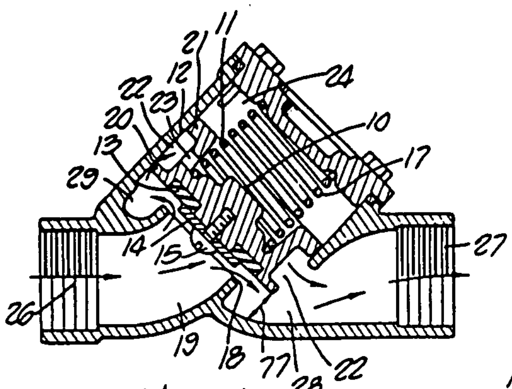

FIG. 1.

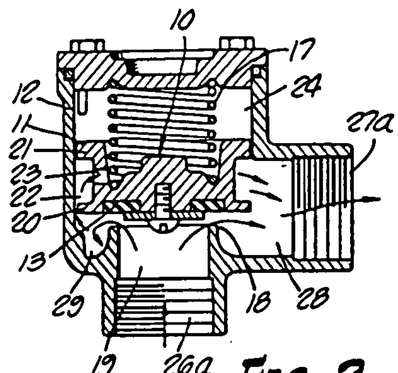

FIG. 2.

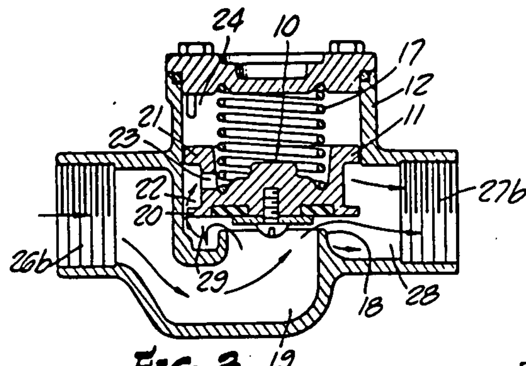

FIG. 3.

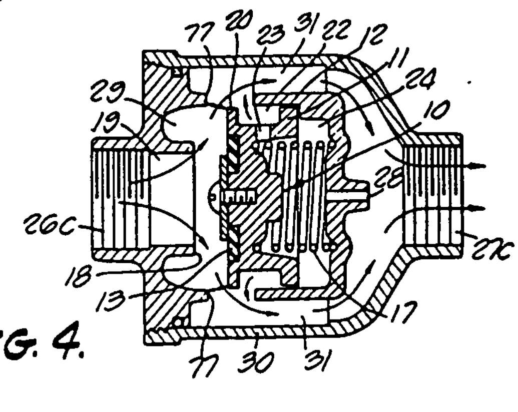

FIG. 4.

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F16K 15-10 AT: 24.10.1974 OT: 30.04.1975

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DEMANDE DE BREVET D'INVENTION

(21) N° 81 14144

(54) Appareil empêchant l'écoulement d'un fluide en sens contraire à la normale et comportant une soupape de sûreté, notamment pour l'alimentation en eau d'une grosse installation d'irrigation de cultures.

(51) Classification internationale (Int. CL ³). F 16 K 17/08; A 01 G 25/00.

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(71) Déposant : Société dite : THE TORO COMPANY, résidant aux EUA.

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La présente invention concerne de façon générale les vannes antiretour et en particulier les soupapes de retenue et de décharge utilisées dans de telles vannes.

Les vannes antiretour sont utilisées dans des systèmes d'irrigation et des systèmes analogues pour assurer que l'écoulement du fluide se fasse seulement dans un sens. Dans les grosses installations d'irrigation, différents fertilisants et des substances nutritives sont généralement mélangés avec l'eau qui est apportée aux cultures par arrosage ou d'une autre manière. Comme une conduite de distribution d'eau communale assure habituellement l'alimentation en eau de tous les utilisateurs domestiques et industriels d'une zone déterminée, il est important d'empêcher le reflux de ces fertilisants et de ces substances nutritives pour éviter qu'ils ne polluent l'eau utilisée à des fins domestiques.

De gros efforts ont déjà été consacrés à la mise au point de vannes antiretour qui se ferment rapidement sous des conditions qui entraînent normalement un reflux, telles que l'établissement d'une contre-pression ou le risque d'un effet de siphon. Comme les vannes antiretour dont il est question ici possèdent habituellement un orifice d'admission et un orifice de sortie qui communiquent chacun avec une chambre intermédiaire, l'un par une soupape de retenue à l'admission et l'autre par une soupape de retenue à la sortie, beaucoup d'efforts ont été consacrés au perfectionnement des soupapes de retenue des vannes antiretour, dans le but d'assurer une fermeture rapide et sûre dès que la pression du fluide dans l'orifice de sortie dépasse la pression du fluide dans l'orifice d'admission.

Par exemple, un dispositif amplificateur a déjà été ajouté aux soupapes de retenue à l'admission et à la sortie pour fermer ces soupapes avec une plus grande force sans augmenter exagérément la résistance à l'ouverture dès le début de l'ouverture de la soupape. Cependant, les systèmes à came pour soupapes de retenue de l'art antérieur demandent généralement plusieurs pièces mobiles et ne procurent qu'un effet amplificateur limité; de plus, ils sont limités par la manière dont l'amplification est appliquée.

Différentes recherches ont également été consacrées à la conception de la soupape de décharge faisant partie des vannes antiretour. Cette soupape communique avec l'orifice d'admission et la chambre intermédiaire et elle a pour but de rejeter du fluide de la chambre intermédiaire à l'atmosphère lorsque la pression dans cette chambre dépasse la pression dans l'orifice d'admission à la fermeture des soupapes de retenue à l'admission et à la sortie au moment où se produit ou risque de se produire un reflux. Le problème posé par la plupart des soupapes de décharge est qu'elles rejettent également du fluide de la chambre intermédiaire à l'atmosphère s'il se produit seulement de brèves élévations de la pression du fluide dans la chambre intermédiaire par rapport à la pression du fluide dans l'orifice d'admission. Ces brèves élévations de pression sont la conséquence d'un refoulement du fluide de la chambre intermédiaire au moment où se produit une forte chute de pression dans l'orifice d'admission. Le "crachotement" de la soupape de décharge sous l'effet de ces élévations de pression momentanées est indésirable.

Les soupapes de décharge de l'art antérieur ne résolvent généralement pas le problème de crachotement car il s'agit le plus souvent de soupapes simples. Les soupapes de décharge connues qui "crachotent" moins sont mécaniquement compliquées et sont sujettes à une usure rapide.

L'invention vise par conséquent à assurer la fermeture rapide et sûre des soupapes de retenue d'une vanne antiretour et à diminuer le crachotement de sa soupape de décharge par absorption de refoulements de fluide transitoires de la chambre intermédiaire sous l'effet de fortes chutes de la pression à l'admission.

L'invention apporte une soupape de retenue perfectionnée pour une vanne antiretour du type comportant un corps de vanne présentant un orifice d'admission destiné à être relié à une source de fluide, une chambre intermédiaire communiquant avec l'orifice d'admission par une première soupape de retenue, ainsi qu'un orifice de sortie communiquant avec la chambre intermédiaire par une seconde soupape de retenue et destiné à être relié à un récepteur de fluide. La soupape de retenue selon l'invention possède un siège fixe communiquant avec la chambre intermédiaire, un clapet mobile profilé

susceptible d'être appliqué de façon étanche contre le siège, ainsi qu'un mécanisme de fermeture de soupape qui est en contact roulant avec le clapet et qui est sensible à une différence de pression du fluide dans la chambre intermédiaire et dans l'orifice d'admission s'il s'agit d'une soupape de retenue à l'admission, ou qui est sensible à une différence de pression du fluide dans la chambre intermédiaire et l'orifice de sortie s'il s'agit d'une soupape de retenue à la sortie. Le mécanisme de fermeture presse le clapet en position de fermeture contre le siège lorsque la pression en amont de la soupape égalise ou dépasse la pression du fluide en aval de la soupape. Selon un mode de réalisation de l'invention, le clapet possède une surface extérieure tronconique formant des profils de came pour le contact roulant avec le mécanisme de fermeture.

L'invention apporte également une soupape de décharge perfectionnée pour vannes antiretour. Cette soupape communique avec l'orifice d'admission de la vanne et avec la chambre intermédiaire et elle évite le rejet de fluide de la chambre intermédiaire à l'atmosphère s'il se produit seulement de brèves élévations de la pression du fluide dans la chambre intermédiaire par rapport à la pression du fluide dans l'orifice d'admission.

D'autres caractéristiques et avantages de l'invention ressortiront plus clairement de la description qui va suivre d'un exemple de réalisation non limitatif, ainsi que des dessins annexés, sur lesquels :

- la figure 1 est une vue en plan d'une vanne antiretour perfectionnée selon l'invention;
- la figure 2 est une coupe de cette vanne, prise suivant le plan II-II de la figure 1 mais à plus grande échelle;
- la figure 3 est une coupe correspondant à la partie supérieure de la figure 2, mais à plus grande échelle encore, montrant les soupapes de retenue à l'admission et à la sortie en position de fermeture;
- la figure 4 est une vue semblable à celle de la figure 3 mais montrant les soupapes de retenue de la vanne antiretour en position d'ouverture; et

- la figure 5 est une coupe prise suivant le plan V-V de la figure 1, mais à plus grande échelle, montrant la soupape de décharge de la vanne antiretour.

La vanne antiretour selon l'exemple de réalisation actuellement préféré de l'invention et représenté sur les dessins, voir en particulier les figures 1 et 2, est désignée dans son ensemble par 10. La vanne 10 est destinée à être installée dans un système d'irrigation ou dans un autre système à écoulement de fluide, comportant une source de fluide et un récepteur de fluide qui doivent être maintenus séparés sauf si les pressions dans le système sont adéquates pour produire un écoulement de fluide de la source au récepteur. L'invention constitue un perfectionnement des vannes antiretour selon les brevets des Etats-Unis d'Amérique n° 3 724 487 et n° 4 080 980 au nom de la demanderesse.

La vanne 10 comprend un corps qui se compose d'une partie inférieure 11, une partie intermédiaire 39, une partie supérieure 40, un couvercle 124 et un corps 150 de soupape de décharge. Toutes ces parties sont maintenues ensemble par des éléments d'assemblage, tels que des vis 49, 152 et 164, ou par d'autres moyens, avec interposition de joints 38, comme représenté, là où cela est nécessaire. Comme décrit dans les brevets cités ci-dessus, toutes ces parties peuvent être moulées.

Du fluide venant d'une source de fluide (non représentée) pénètre dans la vanne 10 par un orifice d'admission 12 ménagé dans la partie inférieure 11 du corps de vanne. Sur cet orifice est branché un tuyau d'arrivée 12a venant de la source de fluide. A partir de l'orifice d'admission 12, le fluide entre dans une chambre intermédiaire 13 formée par la partie supérieure 40 et le couvercle 124 du corps de vanne. La chambre 13 communique avec l'orifice d'admission 12 par une soupape de retenue d'admission 80. A partir de la chambre intermédiaire 13, le fluide entre dans un orifice de sortie 40 qui communique avec la chambre 13 par une soupape de retenue de sortie 100 et sur lequel est branché un tuyau de sortie 11a qui mène à un récepteur de fluide (non représenté). L'orifice d'admission 12 et l'orifice de sortie 14 sont tous deux venus de moulage et situés dans la partie inférieure 11 du corps de vanne.

Comme représenté, ils sont tous deux filetés intérieurement pour le raccordement des extrémités filetées des tuyaux d'arrivée 12a et de sortie 11a.

La partie inférieure 11 du corps de vanne constitue également la partie inférieure de deux robinets à boulet 70 et 75 qui sont prévus, l'un pour régler l'écoulement de fluide par l'orifice d'admission 12, l'autre pour régler l'écoulement de fluide par l'orifice de sortie 14. La partie inférieure 11 peut être semblable à celle décrite dans le brevet des Etats-Unis d'Amérique n° 3 724 487 au nom de la demanderesse. Le robinet d'admission 70 est monté dans une chambre 52 contenant un joint de robinet 53. Le robinet de sortie 75 est monté dans une deuxième chambre 57 contenant un joint de robinet 58. Les joints 53 et 58 permettent la rotation des boulets 70 et 75 pour aligner les passages 72 et 77 des boulets avec l'orifice d'admission 12 et l'orifice de sortie 14. La partie intermédiaire 39 du corps de vanne possède une paroi latérale cylindrique 41 qui présente en bas un rebord périphérique 41a appliqué contre la surface supérieure de la partie 11, à laquelle la partie intermédiaire 39 est fixée d'une manière appropriée quelconque, par exemple par collage ou vissage, de sorte que les robinets à boulet 70 et 75 restent bien en place entre la partie inférieure et la partie intermédiaire du corps de vanne.

Une clé 78, reliée au boulet 75 par un axe 90, fait saillie à l'extérieur de la partie intermédiaire 39 et se termine par une partie transversale ou levier, comme on peut le voir sur la figure 1. Les deux robinets à boulet 70 à 75 sont réalisés et manoeuvrés de façon analogue. La clé pour le robinet d'admission 70 n'est pas représentée pour simplifier le dessin. Le boulet 70 à l'admission peut donc être tourné par une clé semblable à celle désignée par 78 pour le robinet de sortie entre une position d'ouverture, où le passage 72 est aligné avec l'orifice d'admission 11 et la soupape de retenue à l'admission 80, et une position de fermeture où le passage 72 ne communique pas avec l'orifice d'admission ni avec la soupape 80. De façon analogue, le boulet du robinet de sortie 75 peut être tourné entre une position d'ouverture, où le passage 77 est aligné avec l'orifice de sortie 14, et une position

de fermeture. L'écoulement de fluide, réglé manuellement par les robinets à boulet 70 et 75, est également réglé automatiquement, de manière à éviter le reflux, par les soupapes de retenue 80 et 100.

Les figures 3 et 4 représentent de façon détaillée la construction de la soupape de retenue d'admission 80 et la soupape de retenue de sortie 100. La figure 3 montre ces deux soupapes en position fermée, comme cela serait le cas s'il n'y a pas d'écoulement de fluide à travers la vanne. La figure 4 les montre en position d'ouverture, où du fluide peut s'écouler de l'orifice d'admission 12 à travers la chambre intermédiaire 13 vers l'orifice de sortie 14.

La figure 3 montre que la soupape de retenue 80 à l'admission possède un siège rehaussé 200 à peu près cylindrique, dont l'ouverture sensiblement circulaire en haut est désignée par 202. Il porte en outre un joint annulaire 204 de section carrée qui contribue à étancher l'orifice d'admission 12. Le siège 200 peut être fermé par un clapet 206 mobile dans le sens vertical au-dessus de lui. La surface extérieure du clapet 206 est à peu près tronconique et est définie par un bord périphérique 208 sensiblement horizontal, une partie médiane conique 212 agissant à la façon d'une surface de came et une partie supérieure concave ayant la forme d'une gorge annulaire 214. Le bord périphérique 208 du clapet présente en bas une nervure circulaire 210 de section triangulaire, avec une pointe dirigée vers le bas, qui est pressée contre le joint 204 quand la soupape 80 occupe la position de fermeture représentée figure 3. Le clapet 206 comporte en outre un appendice tubulaire de guidage 242 qui est situé sur l'axe du clapet et est dirigé vers le bas.

Bien que les figures 3 et 4 représentent un clapet 206 de forme sensiblement circulaire, il est à noter que ce clapet pourrait également être non circulaire, sans sortir du cadre de l'invention, à condition qu'il présente deux rampes de came 212, 213 avec deux parties concaves 214, 215 disposées symétriquement sur des côtés opposés du clapet.

Le clapet 206 de la soupape de retenue 80 à l'admission possède la forme particulière qui vient d'être décrite en raison de sa coopération avec un mécanisme de fermeture de soupape fixé à l'intérieur du couvercle 124. Comme représenté figure 3, ce mécanisme

comprend une tige de guidage 240 pénétrant dans l'appendice tubulaire 242 du clapet et deux leviers 230, 232 suspendus oscillants par des axes 236, 238 à un support 234 fixé au couvercle par des vis 244, 246. Les leviers 230, 232 peuvent osciller, de part et d'autre de la tige de guidage 240, dans un plan commun et ils sont tirés l'un vers l'autre et vers la tige 240 par un ressort 228 tendu entre les leviers, où ce ressort est accroché sur des chevilles 224, 226.

Les leviers 230, 232 sont en contact roulant avec le clapet mobile 206 par deux galets de came 216, 222, montés rotatifs sur les leviers par des axes 218, 220, éventuellement avec interposition de paliers en Téflon ou un matériau analogue, les axes 218 et 220 pouvant eux-mêmes avoir un diamètre relativement petit. Les galets 216, 222 transfèrent la force du ressort 228 au clapet 206 et le pressent en position fermée contre le siège 200 lorsque la pression dans la chambre intermédiaire 13 est supérieure à la pression dans l'orifice d'admission 12. Pour ce qui concerne le diamètre relativement petit des axes 218, 220 supportant les galets 216, 222, ce diamètre pourrait être de l'ordre de 3 mm seulement pour un diamètre de l'ouverture 202 du siège d'environ 150 mm; ce diamètre pourrait être d'environ 0,8 mm pour un diamètre d'ouverture de siège d'environ 25 mm.

Lorsque la pression du fluide dans l'orifice d'admission 12 est supérieure à la pression dans la chambre intermédiaire 13 majorée de la force du ressort 228, le clapet 206 est repoussé vers le haut sur la tige 240 par la pression du fluide à l'admission, comme représenté figure 4, jusqu'à ce que les galets 216, 222 se trouvent en bas des rampes formées par la partie conique 212 du clapet; le fluide peut alors s'écouler librement à travers la soupape de retenue 80. A mesure que la pression du fluide dans l'orifice d'admission 12 diminue par rapport à la pression de la chambre intermédiaire 13, le ressort 228 approche le clapet 206 du siège 200, par l'intermédiaire des galets 216, 222 roulant sur la partie conique 212 du clapet. Le clapet 206 finit ainsi par être appliqué contre le siège 200, ce qui arrête l'écoulement de fluide par la soupape de retenue 80. En quelque sorte, l'écoulement de fluide par la soupape 80 produit donc son ouverture et sa fermeture.

Quand la soupape 80 est complètement fermée, les galets 216, 222 sont en appui sur un "faux plat" 214' situé en bas de la partie supérieure concave 214 de la surface extérieure du clapet 206. La faible inclinaison de ce faux plat augmente la force de fermeture et la différence de pression quand le débit de fluide par la soupape de retenue est faible. Le changement de pente entre la partie conique 212 et le faux plat 214' crée également une résistance initiale à l'ouverture du clapet 206, ce qui a pour résultat que la pression de l'orifice d'admission 12 doit être clairement supérieure à la pression de la chambre intermédiaire 13 pour que la soupape puisse être ouverte.

Quand la soupape est fermée, les galets 216, 222 étant en appui sur les faux plats 214', une force d'ouverture d'environ 0,42 kg/cm^2 peut être nécessaire, le ressort 228 étant choisi ou taré en conséquence. Dès que la soupape est légèrement ouverte, comme les galets sont passés sur la partie conique 212 du clapet 206, la force d'ouverture nécessaire peut tomber à environ 0,21 kg/cm^2. Lorsque les galets ont atteint le bord 208, la force d'ouverture est descendue à environ 0,14 kg/cm^2.

La partie supérieure de la gorge 214 en haut du clapet constitue également une butée pour les galets 216, 222 lorsque la soupape de retenue est retirée de la vanne. Au montage de la soupape dans la vanne, les galets 216, 222 sont en appui sur le faux plat 214', sans être en contact avec la partie supérieure de la gorge 214.

Il ressort de ce qui précède que la soupape de retenue selon l'invention est très compacte et ne comporte qu'un petit nombre de pièces mobiles. Les soupapes de retenue utilisées dans les vannes antiretour de l'art antérieur comportent généralement un piston circulaire supportant un ressort axial qui rappelle le piston vers la position de fermeture de la soupape. La disposition du piston et de son ressort l'un derrière l'autre donne une construction relativement longue et supprime toute possibilité d'obtenir un appareil compact. En plus de son faible encombrement, la soupape de retenue selon l'invention a l'avantage d'occasionner une perte de charge, aux débits élevés dans la vanne, qui est nettement inférieure à la perte de charge avec les soupapes de retenue de type à piston de l'art antérieur.

La soupape de retenue 100 à la sortie présente une construction pratiquement identique à celle de la soupape de retenue 80 à l'admission, de sorte que ce qui vient d'être dit au sujet de cette dernière s'applique également, grosso modo, à la soupape 100. Comme le montrent les figures 3 et 4, la soupape de retenue 100 à la sortie possède un siège 300, dont l'ouverture est désignée par 302 et qui comprend un joint 304. Le clapet 306 de cette soupape est disposé mobile verticalement sous le siège 300, sur une tige de guidage 340 montée fixe dans l'appareil. Comme le clapet 206, le clapet 306 possède un bord périphérique 308 sur lequel est moulée une rainure 310 destinée à être pressée contre le joint 304 à la fermeture. De même, le clapet 306 possède une surface de came conique 312 qui fait suite au bord 308 et qui se termine par une gorge 314.

Le clapet 306 est chargé en direction du siège 300 par un mécanisme de fermeture de soupape 390, comprenant la tige 340 et deux leviers 330, 332 qui sont montés oscillants par des axes 336, 338 sur un support 334 fixé par des vis 344, 346 à la partie supérieure 40 du corps de vanne. Comme dans le cas de la soupape de retenue 80, les leviers 330, 332 sont disposés oscillants suivant des arcs de cercle sur des côtés opposés de la tige de guidage 340 et sont tirés vers cette tige par un ressort de traction 328 accroché sur des chevilles 324, 326 portées par les leviers. Les leviers supportent également, sur des axes 318, 320, deux galets 316, 322.

Les galets 316, 332 sont en contact avec la partie conique 312 du clapet 306 et transfèrent à celui-ci la force du ressort 328. La surface conique 312 agit donc à la façon d'une came et les galets 316, 322 travaillent comme des galets de came, pressant le clapet 306 contre le siège 300 lorsque la pression de la chambre intermédiaire 13 est inférieure à la pression de l'orifice de sortie 14 majorée de la force du ressort 328. La soupape de retenue 100 à la sortie, comme la soupape de retenue 80 à l'admission, est donc sensible à la différence de pression entre la chambre intermédiaire 13 et l'orifice d'admission 12 ou de sortie 14. Par conséquent, le débit du fluide s'écoulant par la soupape 100 détermine la position du clapet de cette soupape par rapport au siège.

La soupape 100 à la sortie, comme la soupape 80 à l'admission, est de construction compacte en raison de l'agencement selon l'invention du clapet 306 et du mécanisme de fermeture 390, par lequel le clapet est déplacé sur la tige 340 et est pressé en position fermée contre le siège 30 par le contact roulant et l'action de came entre les galets 316, 322 et la partie conique 312 du clapet.

Les soupapes 80 et 100 selon l'invention permettent de donner au couvercle 124 du corps de vanne une très faible hauteur, ce qui diminue le volume de la chambre intermédiaire 13 et permet d'utiliser la vanne 10 dans des applications où le problème de place est crucial. La vanne antiretour perfectionnée selon l'invention possède une hauteur qui correspond à peu près aux deux tiers de la hauteur de la vanne antiretour selon le brevet des Etats-Unis d'Amérique n° 4 080 980 au nom de la demanderesse et d'autres vannes antiretour semblables.

Les perfectionnements apportés par l'invention concernent également la soupape de décharge 150 de la vanne antiretour. Comme le montrent les figures 1 et 5, la soupape 150 est attachée à la partie supérieure 40 du corps de la vanne antiretour 10 par des vis 152 ou des éléments de fixation analogues. La soupape de décharge 150 possède un corps en trois parties : une partie inférieure 154 qui communique avec l'atmosphère, une partie intermédiaire 156 communiquant avec la partie inférieure et avec la chambre intermédiaire 13, et une partie supérieure 158 communiquant avec la partie intermédiaire 156 et avec l'orifice d'admission 12. Les trois parties 154, 156 et 158 peuvent être maintenues ensemble par des moyens d'assemblage quelconques, par exemple par des vis 192 qui les traversent de part en part, avec interposition de joints.

La figure 5 est une coupe axiale de la soupape de décharge 150 selon l'invention. Cette soupape communique avec l'orifice d'admission 12 (si le robinet 70 est ouvert) par une tuyère 186 qui traverse la paroi à peu près cylindrique du siège 200 de la soupape de retenue 80 à l'admission. La tuyère 186 est étanchée par rapport à la chambre intermédiaire 13 par des joints toriques 187 ou des moyens analogues. Elle établit une communication entre l'orifice d'admission 12 et le côté supérieur d'un diaphragme

178 - composé d'une coupelle rigide et d'un recouvrement circulaire flexible 180 - disposé dans la partie supérieure 158 du corps de la soupape de décharge 150. Une communication est en outre établie entre la chambre intermédiaire 13 et le côté inférieur du diaphrame 178, par un orifice 188 dans la partie supérieure 40 du corps de la vanne antiretour.

Le diaphragme 178 est mobile verticalement dans une cavité cylindrique 190 définie par la partie supérieure 158 et la partie intermédiaire 156 du corps de la soupape de décharge. Le bord circulaire du recouvrement flexible 180 du diaphragme est serré entre la partie intermédiaire 156 et la partie supérieure 158 du corps de la soupape 150. Ce recouvrement assure la séparation entre, d'une part, le fluide venant de l'orifice d'admission et se trouvant du côté supérieur du diaphragme 178, d'autre part, le fluide venant de la chambre intermédiaire 13 et se trouvant sous le diaphragme 178.

Le diaphragme 178 avec son recouvrement extérieur flexible 180 constitue ainsi un moyen pour comparer la pression du fluide dans l'orifice d'admission 12 avec la pression du fluide dans la chambre intermédiaire 13. Si la pression de l'orifice d'admission est supérieure à la pression de la chambre intermédiaire, le diaphragme 178 descend dans la cavité cylindrique 190, voir la figure 5. Inversement, si la pression dans la chambre 13 est égale à la pression de l'orifice d'admission 12, le diaphragme 178 monte dans cette cavité.

Un clapet équilibré 162 de forme cylindrique circulaire est disposé entre le diaphragme 178 et un siège de soupape fixe 160, présentant une surface de siège élastique 170, qui est attaché à la partie inférieure 154 du corps de la soupape de décharge 150. Comme il ressort de la figure 5, le clapet équilibré 162 est mobile entre une position d'ouverture et une position de fermeture de soupape par rapport au siège fixe 160. Une membrane annulaire flexible 166, fixée par son bord extérieur entre la partie inférieure 154 et la partie intermédiaire 156 du corps de la soupape 150 et dont le bord intérieur est fixé au clapet 162, maintient ce dernier mobile dans le sens vertical dans la partie inférieure 154. Lorsque le clapet équilibré 162 est fermé, c'est-à-dire lorsqu'il

est appliqué contre le siège 160, comme représenté en traits mixtes sur la figure 5, le fluide contenu dans la soupape de décharge 150 est empêché de s'échapper à l'atmosphère à travers la partie inférieure 154 de la soupape. Le clapet 162 s'écarte de son siège 160 quand la pression de la chambre intermédiaire 13 dépasse celle de l'orifice d'admission 12.

Les caractéristiques nouvelles de la soupape de décharge 150, évitant dans une forte mesure les décharges de fluide lorsqu'il se produit des élévations transitoires de la pression dans la chambre intermédiaire par rapport à la pression dans l'orifice d'admission, résident dans la disposition du clapet équilibré 162 et du diaphragme 178. Ce dernier est couplé au clapet 162 par un premier ressort de compression 176 maintenu entre un épaulement intérieur 182 du diaphragme 178 et un épaulement intérieur 174 de la partie supérieure du clapet 162. Entre le siège fixe 160 et un épaulement intérieur 172 de la partie inférieure de ce clapet est disposé un second ressort de compression 164.

Le premier ressort 176 communique élastiquement l'abaissement du diaphragme 178, du fait que la pression de l'orifice d'admission est supérieure à la pression de la chambre intermédiaire, au clapet équilibré 162, l'appliquant contre le siège 160, fermant ainsi la soupape de décharge et empêchant le rejet de fluide de la chambre intermédiaire à l'atmosphère. En revanche, le second ressort 164 tend à écarter le clapet 162 de son siège, contre la force d'abaissement exercée par le diaphragme 178 et transmise au clapet 162 par le premier ressort 176. L'agencement est tel que, si la pression du fluide dans l'orifice d'admission 12 est supérieure à la pression du fluide dans la chambre intermédiaire 13, le diaphragme 178 est abaissé suffisamment par la pression à l'admission pour que le clapet 162 soit pressé en position fermée contre la surface élastique 170 du siège fixe 160, ce qui empêche le rejet de fluide de la chambre intermédiaire 13 à l'atmosphère.

Si la pression de la chambre intermédiaire est à peu près égale à celle de l'orifice d'admission, le diaphragme 178 est suffisamment soulevé par la pression de la chambre intermédiaire pour que le ressort inférieur 164 puisse lever le clapet 162 de son

siège 160. La chambre intermédiaire est ainsi mise en communication avec l'atmosphère, ce qui permet l'échappement de fluide de cette chambre à l'extérieur, jusqu'à ce que la pression dans la chambre soit ramenée à une valeur inférieure à la pression dans l'orifice d'admission.

La disposition du clapet 162 entre les ressorts 176 et 164 empêche l'ouverture de la soupape de décharge sous l'effet de changements de pression de courte durée seulement de la chambre intermédiaire par rapport à l'orifice d'admission. Plus précisément, la disposition des deux ressorts coopérants 176 et 164 crée à l'intérieur de la soupape de décharge un mécanisme amortisseur ou d'absorption de forces qui permet au diaphragme 178 de monter et de descendre dans sa cavité cylindrique 190, sous l'effet de changements rapides de la pression dans la chambre intermédiaire, sans que cela provoque la levée du clapet équilibré 162.

La nouvelle conception de la valve de décharge non seulement diminue le crachotement, elle permet aussi une construction bien plus compacte que celle des soupapes de décharge utilisées dans les vannes antiretour de l'art antérieur. La soupape de décharge selon l'invention travaillerait comme une soupape de décharge de l'art antérieur si le premier ressort 176 était absent et si le diaphragme 178 était relié directement au clapet 162. Une telle soupape crachoterait en cas de fluctuations de la pression d'alimentation de la vanne antiretour. Par exemple, en cas de variation de la pression d'alimentation entre 3 et 7,3 bars, la montée de la pression d'alimentation à 7,3 bars serait suivie par la montée de la pression dans la chambre intermédiaire, jusqu'à 6,9-7 bars par exemple. Bien entendu, la pression en aval de la vanne antiretour s'élèverait également. Lors de l'abaissement consécutif de la pression d'alimentation, à 3 bars par exemple, la soupape de retenue à la sortie se fermerait et empêcherait l'eau de refluer de l'orifice de sortie dans la chambre intermédiaire. Cependant, au moment de la fermeture de la soupape de retenue à la sortie, il s'établirait une grande différence de pression sur elle, pressant le clapet de cette soupape avec une grande force contre le siège. Il en résulterait un refoulement d'eau dans la chambre intermédiaire et, partant, une

élévation de la pression dans la chambre intermédiaire (parce que la soupape de retenue à l'admission serait déjà fermée).

Lors d'une élévation consécutive de la pression d'alimentation de la vanne, à 3,65 bars par exemple, la pression de la chambre intermédiaire devrait être réduite, parce que, pendant le service normal, la pression de la chambre intermédiaire est inférieure à la pression de l'orifice d'admission du fait que la chambre possède une plus grande section que l'orifice. La pression de la chambre intermédiaire devrait donc être abaissée à 3,2-3,35 bars par exemple. A cet effet, de l'eau devrait être refoulée de la chambre intermédiaire à la soupape de décharge. En raison de la liaison rigide entre le diaphragme 178 et le clapet 162, ce refoulement produirait un crachotement, c'est-à-dire une expulsion d'une partie de l'eau de la chambre intermédiaire par la soupape de décharge. La liaison élastique selon l'invention entre le diaphragme et le clapet de la soupape de décharge élimine ce crachotement.

Dans la soupape selon l'invention, la montée du diaphragme 178 permet d'absorber, dans le cas d'un refoulement comme décrit plus haut, la quantité d'eau nécessaire pour abaisser la pression dans la chambre intermédiaire dans la mesure requise, sans que le clapet 162 s'écarte de son siège 160, de sorte qu'il n'y a plus d'expulsion d'eau à l'extérieur. La différence de pression normale entre l'admission et la chambre intermédiaire est d'environ 0,42 bar. Si cette différence descend à 0,21 bar environ, le clapet 162 commence à se soulever de son siège. Si les caractéristiques du premier ressort 176 ont été fixées convenablement, le diaphragme 178 peut s'élever d'une hauteur considérable avant que la différence de pression normale d'environ 0,42 bar soit réduite à la moitié environ, c'est-à-dire à la valeur d'environ 0,21 bar à laquelle la soupape de décharge s'ouvre. Cette liberté de mouvement du diaphragme permet à la soupape de décharge d'absorber des refoulements, produits par des fluctuations de la pression d'alimentation, sans que cela s'accompagne de rejets d'eau à l'extérieur.

Comme les autres pièces de la vanne antiretour selon l'invention, les parties supérieure, intermédiaire et inférieure du corps de la soupape de décharge, de même que la coupelle du diaphragme

178 et le clapet 162, peuvent être des pièces moulées en matière plastique ou analogue. La construction compacte de la soupape de décharge 150, en combinaison avec la construction compacte des soupapes de retenue 80 et 100 à l'admission et à la sortie, permet la réalisation d'une vanne antiretour de très faible hauteur, de conception efficace et d'aspect esthétique.

La description qui précède ne porte que sur un mode de réalisation préféré de l'invention. Il va de soi que de nombreuses modifications mécaniques et de conception sont possibles sans sortir du cadre de l'invention. Par exemple, les clapets mobiles des soupapes de retenue pourraient avoir des surfaces extérieures différentes pour obtenir l'action désirée du contact roulant entre le mécanisme de fermeture et le clapet; le mécanisme de fermeture pourrait utiliser des galets disposés différemment sur le clapet; les deux galets représentés pourraient être remplacés par un seul galet monté sur le corps de vanne avec interposition d'un ressort; les sièges des soupapes de retenue pourraient avoir des formes différentes de celles décrites et représentées; la soupape de décharge pourrait être équipée d'autres moyens pour déplacer le clapet élastiquement entre la position d'ouverture et la position de fermeture; le diaphragme de cette soupape pourrait être remplacé par un autre moyen pour comparer la pression dans l'orifice d'admission avec la pression dans l'orifice de sortie (chambre intermédiaire); des moyens autres qu'une tuyère pourraient être utilisés pour prélever la pression du fluide dans l'orifice d'admission; et le diaphragme et le clapet cylindrique de la soupape de décharge pourraient être remplacés par des éléments de formes différentes pour obtenir les résultats désirés.

REVENDICATIONS

1. Soupape de retenue pour une vanne antiretour dont le corps possède un orifice d'admission destiné à être relié à une source de fluide, une chambre intermédiaire communiquant avec l'orifice d'admission par une première soupape de retenue, ainsi qu'un orifice de sortie communiquant avec la chambre intermédiaire par une seconde soupape de retenue et destiné à être relié à un récepteur de fluide, caractérisée en ce qu'elle comprend un siège fixe (200, 300) communiquant avec la chambre intermédiaire (13), un clapet mobile profilé (206, 306) capable de fermer ce siège, de même qu'un mécanisme de fermeture de soupape (290, 390) sensible, dans la soupape de retenue (80) à l'admission et dans la soupape de retenue (100) à la sortie, à la différence de pression du fluide dans la chambre intermédiaire et du fluide dans l'orifice d'admission (12) ou dans l'orifice de sortie (14), pour appliquer le clapet en position de fermeture de soupape contre le siège lorsque la pression du fluide dans la chambre intermédiaire s'élève par rapport à la pression du fluide dans l'orifice d'admission, ou lorsque la pression du fluide dans l'orifice de sortie s'élève par rapport à la pression du fluide dans la chambre intermédiaire, le mécanisme de fermeture étant en contact roulant avec le clapet et comprenant une tige fixe (240, 340) sur laquelle se déplace le clapet.

2. Soupape de retenue selon la revendication 1, caractérisée en ce que le siège possède une ouverture cylindrique (202, 302) ménagée dans ledit corps de vanne (11, 39, 40, 124), de même qu'un joint annulaire (204, 304), contre lequel vient s'appliquer le clapet (206, 306).

3. Soupape de retenue selon la revendication 2, caractérisée en ce que le clapet (206, 306) possède une cavité axiale (252, 342) pour la réception de la tige (240, 340), de même qu'une surface extérieure tronconique pour le contact roulant avec le mécanisme de fermeture (290, 390).

4. Soupape de retenue selon la revendication 3, caractérisée en ce que le clapet (206, 306) présente une nervure (210, 310) destinée à être en contact avec le joint annulaire (204, 304) quand

le clapet est appliqué en position de fermeture de la soupape contre le siège (200, 300).

5. Soupape de retenue selon la revendication 1, caractérisée en ce que le clapet (206, 306) présente des rampes profilées (208, 212, 214; 308, 312, 314) pour le contact roulant avec le mécanisme de fermeture, de même qu'une cavité (242, 342) pour la réception de ladite tige (240, 340), la soupape de retenue s'ouvrant et se fermant en réponse à ladite différence de pression et en glissant le long de la tige (240, 340) sous la poussée exercée par le mécanisme de fermeture (290, 390).

6. Soupape de retenue selon la revendication 5, caractérisée en ce que les rampes profilées comprennent deux rampes (212, 214; 213, 215) disposées symétriquement sur des côtés opposés de la tige (240) pour le contact roulant avec le mécanisme de fermeture).

7. Soupape de retenue selon la revendication 1, caractérisée en ce que le mécanisme de fermeture de soupape comporte une tige fixe (240, 340) montée sur le corps de vanne (11, 39, 40, 124) et sur laquelle coulisse le clapet (206, 306), des galets ou d'autres éléments roulants (216, 222; 316, 322) destinés à venir en contact avec le clapet profilé, des leviers (230, 232; 330, 332) reliés au corps de vanne et pouvant effectuer des mouvements suivant un arc de cercle dans un plan parallèle à la tige (240, 340), en vue de l'application des galets contre le clapet profilé, de même qu'un ressort (228, 328) reliant les leviers entre eux et les chargeant dans le sens de l'application des galets contre le clapet, de telle manière que :

a) le clapet est écarté de son siège, c'est-à-dire ouvert, par l'écoulement de fluide à travers la soupape de retenue lorsque la pression du fluide côté source de fluide du clapet est supérieure à la pression du fluide côté récepteur de fluide du clapet majorée de la force du ressort, et

b) le clapet est fermé, c'est-à-dire appliqué contre son siège, par le ressort, coopérant avec les galets, lorsque l'écoulement de fluide à travers la soupape de retenue cesse.

8. Soupape de retenue selon la revendication 1, caractérisée en ce que la soupape de retenue (80) à l'admission et la soupape de

retenue (100) à la sortie sont disposées dans la chambre intermédiaire (13), ce qui permet de donner une faible hauteur au corps (11, 39, 40, 124) de la vanne antiretour.

9. Vanne antiretour, dont le corps possède un orifice d'admission destiné à être relié à une source de fluide, une chambre intermédiaire communiquant avec cet orifice d'admission par une soupape de retenue d'admission, un orifice de sortie communiquant avec la chambre intermédiaire par une soupape de retenue de sortie et destiné à être relié à un récepteur de fluide, une soupape de décharge, reliée à l'orifice d'admission et à la chambre intermédiaire, qui décharge du fluide de la chambre intermédiaire à l'atmosphère lorsque la pression du fluide dans cette chambre est égale à la pression du fluide dans l'orifice d'admission, chaque soupape de retenue comprenant un siège et un clapet déplaçable entre une position d'ouverture et une position de fermeture par rapport au siège, caractérisée en ce que chaque soupape de retenue comporte un mécanisme de fermeture de soupape (290, 390) qui est en contact roulant et glissant avec le clapet (206, 306) et qui est sensible, dans la soupape de retenue d'admission (80) et dans la soupape de retenue de sortie (100), à la différence des pressions de fluide dans la chambre intermédiaire (13) et dans l'orifice d'admission (12) ou l'orifice de sortie (14), pour presser le clapet (206, 306) à la position de fermeture contre le siège (200, 300) lorsque la pression de fluide du côté amont diminue par rapport à la pression de fluide sur le côté aval de la soupape considérée.

10. Vanne antiretour selon la revendication 9, caractérisée en ce que le siège (200, 300) présente une ouverture (202, 302) sensiblement cylindrique, qui est ménagée dans le corps de vanne (11, 39, 40, 124) entre la chambre intermédiaire et l'orifice d'admission (12) ou l'orifice de sortie (14), et en ce que le clapet (206, 306) présente une surface tronconique en contact roulant avec le mécanisme de fermeture, de même qu'une cavité axiale (242, 342) pour le contact glissant avec ce mécanisme de fermeture, le clapet étant pressé à sa position de fermeture de soupape par l'application d'une force à la surface tronconique par le contact roulant avec le mécanisme de fermeture.

11. Vanne antiretour selon la revendication 10, caractérisée en ce que le mécanisme de fermeture de soupape comporte une tige fixe (240, 340) montée sur le corps de vanne pour le contact glissant avec la cavité axiale du clapet, des galets ou d'autres éléments roulants (216, 222; 316, 322) qui roulent sur la surface tronconique, des leviers (230, 232; 330, 332) reliés au corps de vanne et mobiles suivant des arcs de cercle dans un plan parallèle à la tige (240, 340), en vue de l'application des galets contre le clapet, ainsi qu'un ressort (228, 328) qui relie les leviers entre eux et les charge en vue de l'application des galets contre la surface tronconique, de telle manière que :

a) le clapet (306) de la soupape de retenue de sortie (100) est pressé à la position de fermeture de soupape par le ressort (328) de cette soupape lorsque la pression du fluide dans la chambre intermédiaire est inférieure à la pression du fluide dans l'orifice de sortie majorée de la force fournie par le ressort (328) de la soupape de retenue de sortie et appliquée au clapet de cette soupape par les galets (316, 322), et

b) le clapet (206) de la soupape de retenue d'admission est pressé à sa position de fermeture de soupape par le ressort (228) de cette soupape lorsque la pression du fluide dans l'orifice d'admission est inférieure à la pression du fluide dans la chambre intermédiaire majorée de la force du ressort (228) de la soupape de retenue d'admission.

12. Vanne antiretour selon la revendication 9, caractérisée en ce que la soupape de décharge comporte un corps de soupape (150) dont l'intérieur communique avec la chambre intermédiaire (13) et avec l'atmosphère, un dispositif (186) pour capter la pression du fluide dans l'orifice d'admission (12), un dispositif (188) pour capter la pression du fluide dans la chambre intermédiaire, un dispositif (178), communiquant avec les deux dispositifs capteurs, pour comparer les pressions de fluide dans l'orifice d'admission et dans la chambre intermédiaire et pour absorber des refoulements de fluide de la chambre intermédiaire, produits par d'importantes chutes de la pression dans l'orifice d'admission, ainsi qu'un dispositif à clapet équilibré (162) monté mobile dans le corps de soupape

et couplé élastiquement au dispositif comparateur (178), pour établir seulement une communication entre la chambre intermédiaire et l'atmosphère lorsque la pression du fluide dans la chambre intermédiaire est égale à la pression du fluide dans l'orifice d'admission, le dispositif comparateur maintenant le dispositif à clapet équilibré en une position de fermeture de soupape pendant de brèves chutes de pression dans l'orifice d'admission.

13. Vanne antiretour selon la revendication 12, caractérisée en ce que le dispositif comparateur (177) est formé par un diaphragme qui communique avec l'orifice d'admission et avec la chambre intermédiaire par des liaisons étanchées et qui est couplé élastiquement au dispositif à clapet équilibré (162), dans le but d'amener ce clapet à une position de fermeture de soupape lorsque la pression dans l'orifice d'admission est supérieure à la pression dans la chambre intermédiaire et de permettre à ce clapet de s'ouvrir lorsque la pression dans la chambre intermédiaire est égale à la pression dans l'orifice d'admission.

14. Vanne antiretour selon la revendication 13, caractérisée en ce que le dispositif à clapet équilibré comporte un clapet mobile (162), un premier dispositif élastique (176) placé entre le diaphragme (178) et ce clapet et destiné à transférer la force de fermeture de soupape fournie par le diaphragme au clapet (162) et à permettre au diaphragme de s'écarter du clapet afin d'absorber des refoulements de fluide tout en maintenant la force de fermeture de soupape sur le clapet (162), ainsi qu'un second dispositif élastique (164) placé entre le clapet (162) et le corps de soupape (150), ce second dispositif élastique étant destiné à déplacer le clapet à une position d'ouverture de soupape lorsque la pression de la chambre intermédiaire est égale à la pression de l'orifice d'admission et à s'opposer à la force de fermeture fournie par le diaphragme (178), de sorte que le clapet (162) est disposé élastiquement mobile entre le premier et le second dispositif élastique, le rapport des caractéristiques élastiques de ces deux dispositifs déterminant le volume de fluide refoulé susceptible d'être absorbé par le diaphragme pendant que le clapet (162) est maintenu à sa position de fermeture de soupape, ce qui empêche l'établissement d'une communication entre la chambre

intermédiaire (13) et l'atmosphère s'il se produit seulement des fluctuations transitoires de la pression dans l'orifice d'admission.

15. Vanne antiretour selon la revendication 13, caractérisée en ce que le dispositif (186) pour capter la pression d'admission est une tuyère établissant une liaison étanchée entre l'orifice d'admission et un côté du diaphragme (178) et en ce que le dispositif pour capter la pression dans la chambre intermédiaire (13) comporte un orifice (188) faisant partie d'une liaison étanchée entre la chambre intermédiaire et l'autre côté du diaphragme.

16. Vanne antiretour selon la revendication 14, caractérisée en ce que :

a) le diaphragme (178) comporte une coupelle rigide dont les côtés opposés communiquent avec la tuyère (186) et avec ledit orifice (188), ainsi qu'un recouvrement flexible (180) attaché au corps de soupape (150) et à la coupelle du diaphragme, le recouvrement flexible permettant à la coupelle rigide de se déplacer librement dans le corps de soupape (150) en réponse à des différences de pression du fluide dans l'orifice d'admission (12) et du fluide dans la chambre intermédiaire (13);

b) le dispositif à clapet équilibré comporte un siège de soupape (160) relié rigidement au corps de soupape (150), un clapet creux (162) susceptible d'être appliqué en position de fermeture de soupape contre ce siège, ainsi qu'une membrane annulaire flexible (166) reliée d'un côté au corps de soupape (150) et de l'autre au clapet creux;

c) le premier dispositif élastique est un premier ressort (176) disposé entre la coupelle rigide du diaphragme (178) et le clapet creux (162);

d) le second dispositif élastique est un second ressort (164) disposé entre le clapet creux et le siège (160), l'agencement étant tel que, jusqu'à ce que la différence entre la pression dans l'orifice d'admission et la pression dans la chambre intermédiaire fournisse une force égale et contraire à la force de fermeture résultante des deux ressorts, le diaphragme (178) peut s'écarter du clapet (162), en vue de l'absorption de fluide refoulé depuis la chambre intermédiaire, tout en maintenant le clapet (162) à sa posi-

tion de fermeture, ce qui crée une résistance à l'ouverture de la soupape de décharge par de courts changements de la pression dans l'orifice d'admission.

17. Vanne antiretour, dont le corps possède un orifice d'admission destiné à être relié à une source de fluide, une chambre intermédiaire communiquant avec l'orifice d'admission par une soupape de retenue d'admission, un orifice de sortie communiquant avec la chambre intermédiaire par une soupape de retenue de sortie et destiné à être relié à un récepteur de fluide, ainsi qu'une soupape de décharge, communiquant avec l'orifice d'admission et avec la chambre intermédiaire, qui décharge du fluide de la chambre intermédiaire à l'atmosphère lorsque la pression du fluide dans la chambre intermédiaire est supérieure à la pression du fluide dans l'orifice d'admission, caractérisée en ce que la soupape de décharge comporte un dispositif obturateur qui résiste à la décharge de fluide de la chambre intermédiaire (13) à l'atmosphère sous des fluctuations de la pression dans l'orifice d'admission (12).

18. Vanne antiretour selon la revendication 17, caractérisée en ce que le dispositif obturateur comporte un corps de soupape (150) définissant une cavité de diaphragme (190) qui communique avec l'orifice d'admission (12) et avec la chambre intermédiaire (13), de même qu'un orifice de décharge qui communique avec l'atmosphère, un diaphragme (178) relié élastiquement au corps de soupape, susceptible de se déplacer dans la cavité de diaphragme et présentant des portions communiquant séparément avec l'orifice d'admission et avec la chambre intermédiaire, un obturateur (162) relié élastiquement au corps de soupape (150) et capable d'ouvrir l'orifice de décharge à l'atmosphère, ainsi que des moyens élastiques (176, 164) disposés entre le diaphragme (178) et l'obturateur (162) et entre cet obturateur et le corps de soupape (150) pour supporter l'obturateur de façon équilibrée, l'agencement étant tel que :

a) lorsque la pression dans l'orifice d'admission augmente, le diaphragme s'approche de l'obturateur et les moyens élastiques transfèrent ce mouvement à l'obturateur en déplaçant celui-ci dans le sens de la fermeture de l'orifice de décharge, et

b) lorsque la pression dans la chambre intermédiaire augmente, le diaphragme s'écarte de l'obturateur, permettant ainsi aux moyens élastiques de déplacer l'obturateur dans le sens de l'ouverture de l'orifice de décharge, les moyens élastiques s'opposant élastiquement à cette ouverture sous des changements transitoires de la pression dans l'orifice d'admission.

19. Vanne antiretour selon la revendication 18, caractérisée en ce que les moyens élastiques comprennent un premier ressort (176) placé entre le diaphragme (178) et l'obturateur (162), pour transférer ledit mouvement du diaphragme à l'obturateur et pour permettre au diaphragme de s'écarter de l'obturateur en vue de l'absorption d'augmentations transitoires dans le volume de fluide dans la chambre intermédiaire (13), ainsi qu'un second ressort (164) placé entre l'obturateur et le corps de soupape (150) pour charger l'obturateur dans le sens de l'ouverture de l'orifice de décharge, l'agencement étant tel que :

a) lorsque la pression dans l'orifice d'admission est supérieure à la pression dans la chambre intermédiaire, l'obturateur est déplacé jusqu'à sa position de fermeture de l'orifice de décharge, et

b) lorsque la pression dans la chambre intermédiaire est égale à la pression dans l'orifice d'admission, l'obturateur est déplacé dans le sens de l'ouverture de l'orifice de décharge, les ressorts (176, 164) et le diaphragme (178) résistant à l'ouverture de l'orifice de décharge sous de brèves réductions de la pression dans l'orifice d'admission par l'absorption desdites augmentations de volume de fluide dans la chambre intermédiaire, produites par ces réductions.

20. Vanne antiretour selon la revendication 19, caractérisée en ce que :

a) la soupape de décharge comporte en outre une tuyère (186), communiquant avec l'orifice d'admission (12) et avec la cavité de diaphragme (190), pour transférer la pression de l'orifice d'admission à un côté du diaphragme, et un orifice (188), communiquant avec la chambre intermédiaire et avec le diaphragme, pour transférer la pression de la chambre intermédiaire à l'autre côté du diaphragme;

b) le diaphragme (178) est composé d'une coupelle à peu près cylindrique, dont la portion extérieure communique par une liaison étanchée formée essentiellement par la tuyère (186) avec l'orifice d'admission, en vue de la transmission de la pression dans cet orifice, une portion intérieure de la coupelle communiquant par une liaison étanchée dont fait partie ledit orifice (188) avec la chambre intermédiaire, la coupelle cylindrique présentant un épaulement annulaire (182) pour l'appui d'une extrémité du premier ressort (176), ainsi que d'un recouvrement circulaire flexible (180) attaché à la paroi de la cavité de diaphragme (190) et permettant le mouvement du diaphragme dans cette cavité tout en maintenant une séparation étanche entre l'espace communiquant avec l'orifice d'admission et l'espace communiquant avec la chambre intermédiaire; et

c) le dispositif obturateur comprend un clapet (162) sensiblement cylindrique et creux, qui présente des épaulements annulaires (174, 172) pour l'appui de l'autre extrémité du premier ressort (176) et pour l'appui d'une extrémité du second ressort (164), une membrane annulaire flexible (166) qui relie le clapet cylindrique au corps (150) de la soupape de décharge en vue de son mouvement équilibré rectiligne dans ce corps, pour ouvrir et fermer l'orifice de décharge, ainsi qu'un siège de soupape fixe (160) relié rigidement au corps (150) de la soupape, sur lequel s'appuie l'autre extrémité du second ressort et contre lequel peut venir s'appliquer le clapet cylindrique en vue de la fermeture de l'orifice de décharge.

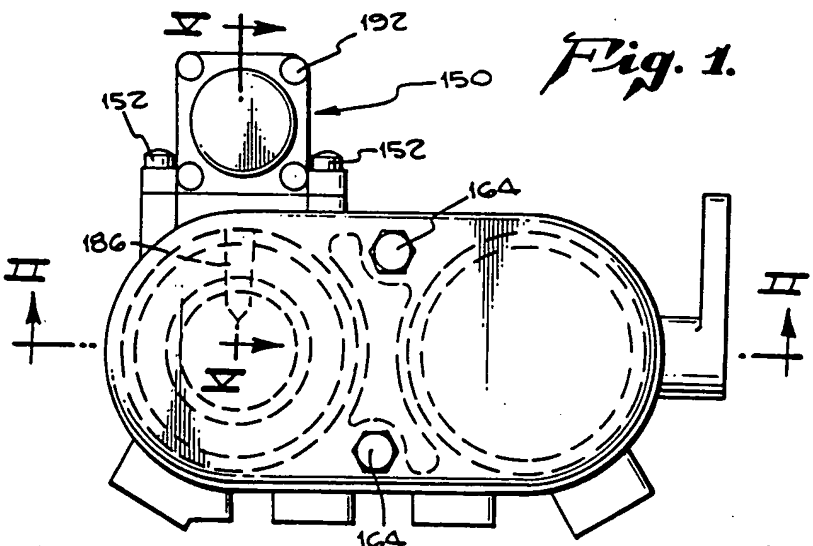
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Fig. 1.

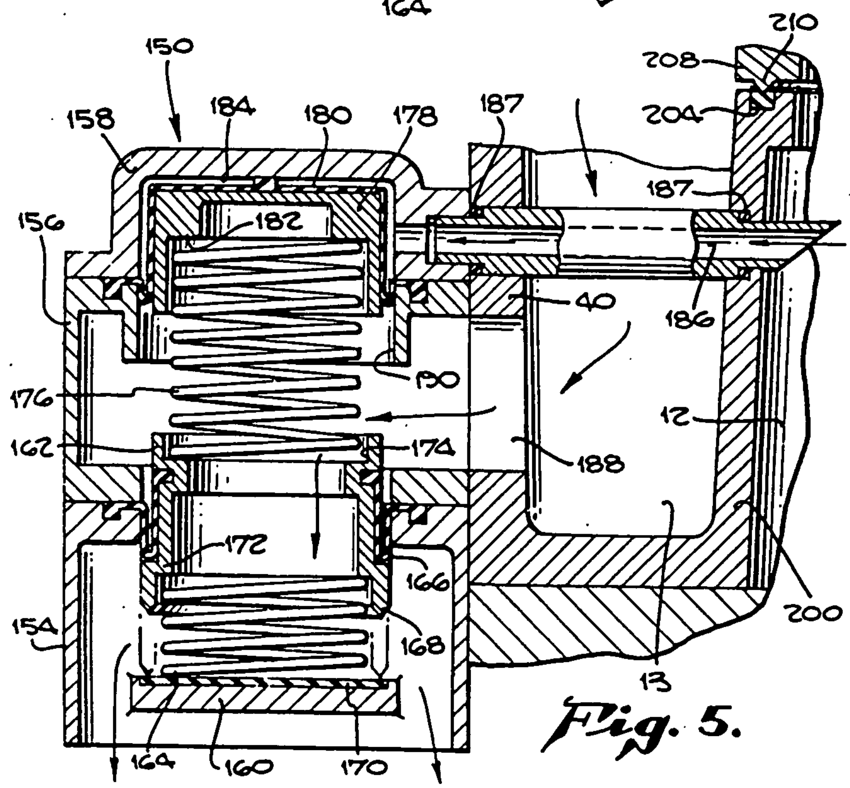
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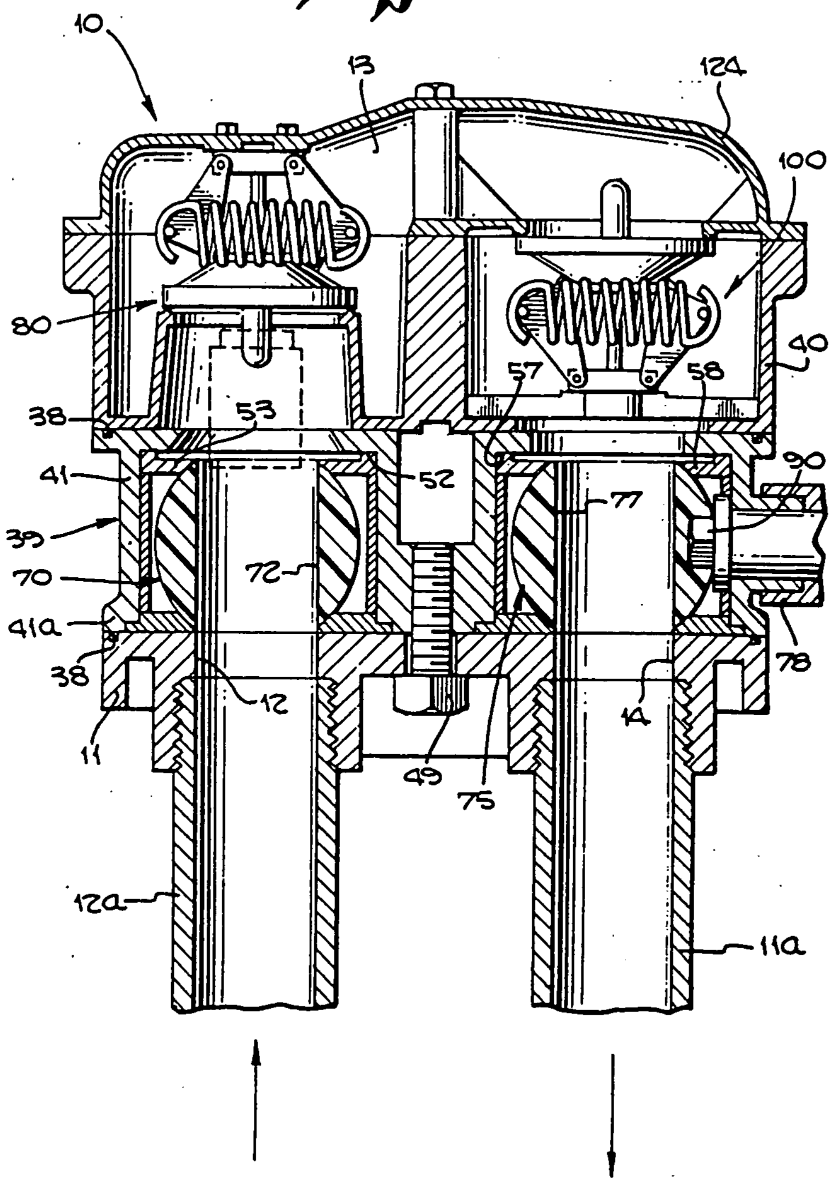
Fig. 5.

Fig. 2.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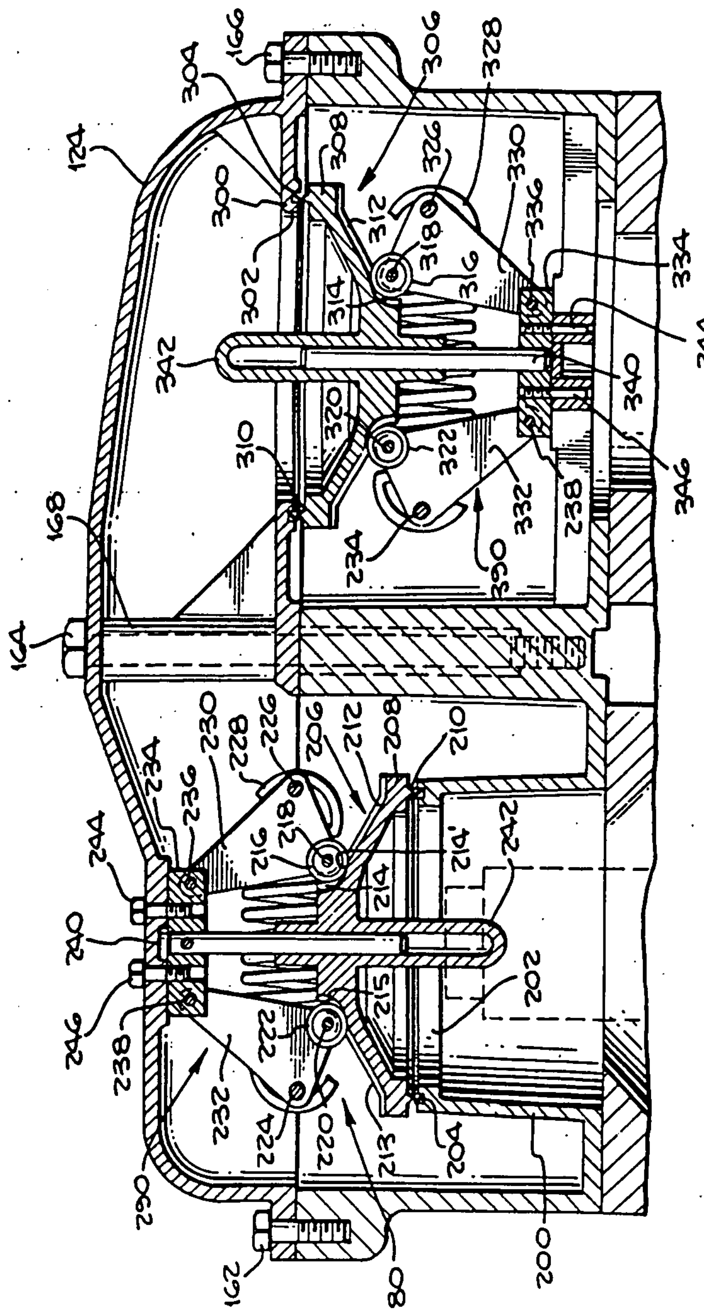
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Fig. 3.

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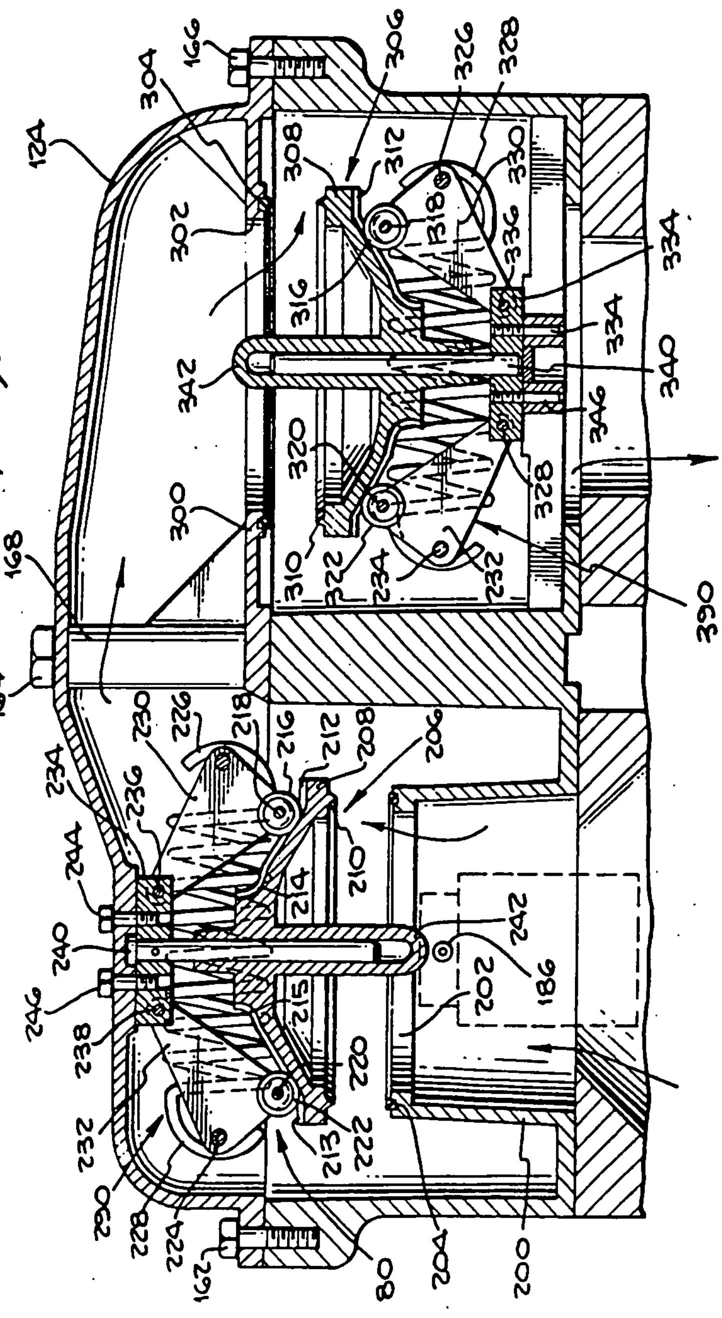

Fig. 4.

DEUTSCHLAND

DEUTSCHES PATENTAMT

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㉑ Aktenzeichen: P 33 30 409.2
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㊸ Offenlegungstag: 14. 3. 85

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⑤④ Rückstaudoppelverschluß

Ein Rückstaudoppelverschluß für Entwässerungsleitungen, bei welchem in einem mit Deckel verschließbaren Gehäuse hintereinander zwei Rückstauklappen gelagert sind, von denen jede ein starres Mittelteil und eine ringförmige Randdichtung aus elastomerem Material aufweist, sich in Durchflußrichtung öffnet und in Rückstaurichtung durch ihr Eigengewicht gegen einen als Gehäusestufe ausgebildeten Klappensitz anliegt, sowie mit einem von der Rückstauseite her auf das starre Mittelteil der einen Klappe einwirkenden, von außen betätigbaren Arretierorgan zum Festlegen der Klappe in der Schließstellung, soll so ausgestaltet sein, daß er mit relativ geringer Anzahl von konstruktiv einfachen Bauteilen auskommt und dadurch einfach zu montieren ist, wobei der Gefälleverlust und die Abmessungen in der Bauhöhe möglichst gering sein sollen. Deshalb hängt die aus Flachmaterial bestehende Randdichtung 24, 26 jeder Klappe 20, 22 in ihrem oberen Bereich einstückig über einem als Scharnier wirkenden Verbindungsabschnitt 36, 38 mit einem in Klappenebene beidseitig vorspringenden Verankerungsteil 60, 70 zusammen, der als Lagerung für die Klappe in eine Aufnahme 41, 62, 72 im Deckel 50 oder Gehäuse 10, 64 eingefügt und durch einen Ansatz 40 des Deckels 50 am Gehäuse 10, 64 festgelegt ist. Ferner ist das Arretierorgan 44 als Schwenkhebel mit im Abstand über dem Klappenscharnier 36 verlaufende horizontale Welle ausgebildet, welche am Gehäuse oder am Deckel in Ausnehmungen gelagert ...

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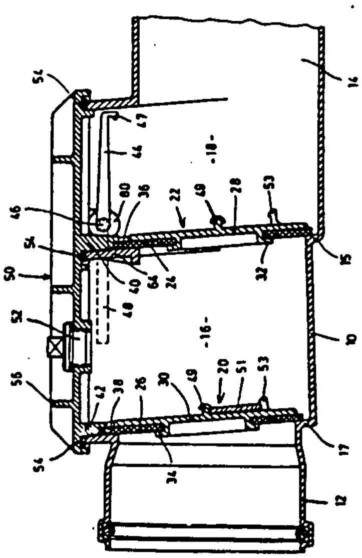

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Rückstaudoppelverschluß

Patentansprüche

1. Rückstaudoppelverschluß für Entwässerungsleitungen mit einem mit Deckel verschließbaren Gehäuse, in dem hintereinander zwei Rückstauklappen gelagert sind, von denen jede ein starres Mittelteil und eine ringförmige Randdichtung aus elastomerem Material aufweist, sich in Durchflußrichtung öffnet und in Rückstaurichtung durch ihr Eigengewicht gegen einen als Gehäusestufe ausgebildeten Klappensitz anliegt, sowie mit einem von der Rückstauseite her auf das starre Mittelteil der einen Klappe einwirkenden, von außen betätigbaren Arretierorgan zum Festlegen der Klappe in der Schließ-

stellung, dadurch g e k e n n z e i c h n e t , daß die aus Flachmaterial bestehende Randdichtung (24, 26) jeder Klappe (20, 22) in ihrem oberen Bereich einstückig über einen als Scharnier wirkenden Verbindungsabschnitt (36, 38) mit einem in Klappenebene beidseitig vorspringenden Verankerungsteil (60, 70) zusammenhängt, der als Lagerung für die Klappe in eine Aufnahme (41, 62, 72) im Deckel (50) oder Gehäuse (10, 64) eingefügt und durch einen Ansatz (40) des Deckels (50) am Gehäuse (10, 64) festgelegt ist, und daß das Arretierorgan (44) als Schwenkhebel mit im Abstand über dem Klappenscharnier (36) verlaufender horizontaler Welle (46) ausgebildet ist, die am Gehäuse oder am Deckel in Ausnehmungen gelagert und durch das Zusammenwirken von Gehäuse und Deckel gesichert ist, wobei sie mindestens in der einen Ausnehmung (68) durch ein als Dichtung ausgebildetes Lager (76) gehalten und durch dieses Lager (76) nach außen geführt ist, wo sie einen Handgriff (48) aufweist.

2. Rückstaudoppelverschluß nach Anspruch 1, dadurch g e k e n n z e i c h n e t , daß das starre Mittelteil (28, 30) der Klappen (20, 22) ein Kunststoff-Formteil mit einem hinterschnittenen Kragen (32, 34), welcher vom entsprechend ausgeschnittenen Flachmaterial des Dicht-

randes (24, 26) hintergriffen wird, ist.

3. Rückstaudoppelverschluß nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß die Randdichtung (24, 26) und das Kunststoff-Formteil (28, 30) beider Klappen gleich geformt sind.

4. Rückstaudoppelverschluß nach Anspruch 1 bis 3, dadurch gekennzeichnet, daß das Verankerungsteil für die Randdichtung (24, 26) ein die Randdichtung (24) umgebender Ring (60) ist, der aus dem gleichen Flachmaterial besteht und mit der Randdichtung einstückig ist.

5. Rückstaudoppelverschluß nach Anspruch 4, dadurch gekennzeichnet, daß die Außenkontur des Verankerungsteils (60) im wesentlichen U-förmig ist.

6. Rückstaudoppelverschluß nach Anspruch 4 oder 5, dadurch gekennzeichnet, daß die Aufnahme für das Verankerungsteil (60) durch eine Nut (62) des Gehäuses (10) gebildet wird, die unmittelbar in der Anschlagebene der Klappe (20, 22) liegt, diese im unteren Bereich umgibt und in die das Verankerungsteil (60) von oben eingeschoben ist.

7. Rückstaudoppelverschluß nach Anspruch 1 bis 3, dadurch gekennzeichnet, daß das Verankerungsteil für die Randdichtung (24) ein im wesentlichen horizontal oberhalb der Randdichtung (24) angeordneter Steg (70) ist, der aus dem gleichen Flachmaterial besteht und mit der Randdichtung einstückig ist.

8. Rückstaudoppelverschluß nach Anspruch 7, dadurch gekennzeichnet, daß die Aufnahme für das Verankerungsteil (70) durch zwei Einhängeleisten (72) gebildet ist, die an der Schottwand (64) angeordnet sind und in die das Verankerungsteil (70) eingehängt ist.

9. Rückstaudoppelverschluß nach Anspruch 7, dadurch gekennzeichnet, daß die Aufnahme für das Verankerungsteil (70) durch zwei seitliche Aufnahmetaschen im Gehäuse (10) gebildet ist, in die die seitlichen Enden des Verankerungsteils (70) von oben eingeschoben sind.

10. Rückstaudoppelverschluß nach Anspruch 7, dadurch gekennzeichnet, daß die Aufnahme für das Verankerungsteil (70) durch eine Ausnehmung (41) im Ansatz (40) des Deckels (50) gebildet ist, in die das Verankerungsteil (70) eingefügt ist.

11. Rückstaudoppelverschluß nach einem der Ansprüche 1 bis 10, dadurch gekennzeichnet, daß der Deckelansatz (40) oder die Aufnahme für das Verankerungsteil eine von der Anschlagebene abweichende Neigung hat, so daß die Klappe (20, 22) mit geringem Druck an ihren Sitz (15, 17, 64) angepreßt wird.

12. Rückstaudoppelverschluß nach einem der Ansprüche 1 bis 11, dadurch gekennzeichnet, daß die Ausnehmung (68) und das darin aufgenommene Dichtungslager (76) für die Welle (46) des Arretierorgans (44) eine U-förmige Innen- bzw. Außenkontur hat.

13. Rückstaudoppelverschluß nach einem der Ansprüche 1 bis 12, dadurch gekennzeichnet, daß der außerhalb des Gehäuses (10) liegende Handgriff (48) des Arretierorgans (44) einen geringeren Durchmesser als die Lagerwelle (46) hat, um ein Aufschieben des Dichtungslagers (76) zu ermöglichen.

14. Rückstaudoppelverschluß nach einem der Ansprüche 1 bis 13, dadurch gekennzeichnet, daß am Deckel (50) oder Gehäuse (10) Rasten (86) zum Arretieren des Handgriffs in Sperrstellung und/oder Offenstellung des Arretierorgans (44) vorgesehen sind.

15. Rückstaudoppelverschluß nach einem der Ansprüche 1 bis 14, dadurch gekennzeichnet, daß an

der Klappe (22) und dem Arretierorgan (44) zusammenwirkende Mittel zum Abheben der Klappe (22) von ihrem Sitz (15, 64) vorgesehen sind.

16. Rückstaudoppelverschluß nach Anspruch 15, dadurch gekennzeichnet, daß die Abhebemittel ein Haken (47) am Ende des Arretierorgans (44) und ein am starren Mittelteil (28) der Klappen (20, 22) angeordneter Knipser (49) sind, wobei der Haken in Schließstellung den Knipser (49) hintergreift und sich beim Öffnen der Klappe (22) selbständig davon löst.

17. Rückstaudoppelverschluß nach einem der Ansprüche 1 bis 16, dadurch gekennzeichnet, daß die Welle (46) des Arretierorgans (44) innerhalb des Gehäuses zwischen Dichtungslagerung (66) bzw. Gehäusewandung (10) und dem Deckelansatz (40) einen Bund (82) aufweist, der die Welle (46) gegen Verschieben entlang ihrer Längsachse sichert.

18. Rückstaudoppelverschluß nach einem der Ansprüche 1 bis 17, dadurch gekennzeichnet, daß die Ausnehmungen (66, 66',78) für die Lagerung der Welle (46) am Gehäuse (10) oder am Deckel (50) die gleichen Abmessungen haben und gleiche Dichtungslager (76, 76') darin aufgenommen sind.

19. Rückstaudoppelverschluß nach Anspruch 18, dadurch g e k e n n z e i c h n e t , daß die Arretierrasten (86) für den Handgriff (48) an beiden Seiten des Deckels (50) an einander entsprechenden Stellen angeordnet sind.

8

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A 72 P/G 1219

Rückstaudoppelverschluß

Beschreibung

Die Erfindung betrifft einen Rückstaudoppelverschluß mit einem mit Deckel verschließbaren Gehäuse, in dem hintereinander zwei Rückstauklappen gelagert sind, von denen jede ein starres Mittelteil und eine ringförmige Randdichtung aus elastomerem Material aufweist, sich in Durchflußrichtung öffnet und in Rückstaurichtung durch ihr Eigengewicht gegen einen als Gehäusestufe ausgebildeten Klappensitz anliegt, sowie mit einem von der Rückstauseite her auf das starre Mittelteil der einen Klappe einwirkenden, von außen

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betätigbaren Arretierorgan zum Festlegen der Klappe in der Schließstellung. Bei bekannten Rückstaudoppelverschlüssen dieser Art werden die Klappen normalerweise mit aufwendigen Gelenkaufhängungen in ihrem Gehäuse aufgehängt. Ferner werden teilweise separate Dichtungen oder Dichtungsträger für die Klappen zum Abdichten des Sitzes verwendet. Auch die Schließmechanik für das von außen betätigbare Arretierorgan, welc normalerweise Spindeln oder Knebel od. dgl. enthält, ist relativ aufwendig und bringt Schwierigkeiten mit der Abdichtung der Lagerung mit sich.

Der Erfindung liegt deshalb die Aufgabe zugrunde, einen Rückstaudoppelverschluß zu schaffen, der mit einer relativ geringen Anzahl von konstruktiv einfachen Bauteilen auskommt und dadurch einfach zu montieren ist, wobei der Gefälleverlust möglichst gering sein sollte. Auch die Abmessungen des Rückstaudoppelverschlusses in der Bauhöhe sollen möglichs gering sein, was vor allem bedeutet, daß der Platzbedarf für die Lagerung der Rückstauklappen und des Arretierorgans möglichst gering sein soll.

Diese Aufgabe wird erfindungsgemäß bei einem Rückstaudoppelverschluß der eingangs genannten Art dadurc

gelöst, daß die aus Flachmaterial bestehende Randdichtung jeder Klappe in ihrem oberen Bereich einstückig über einen als Scharnier wirkenden Verbindungsabschnitt mit einem in Klappenebene beidseitig vorspringenden Verankerungsteil zusammenhängt, der als Lagerung für die Klappe in eine Aufnahme im Deckel oder Gehäuse eingefügt und durch einen Ansatz des Deckels am Gehäuse festgelegt ist, und daß das Arretierorgan als Schwenkhebel mit im Abstand über dem Klappenscharnier verlaufender horizontaler Welle ausgebildet ist, die am Gehäuse oder am Deckel in Ausnehmungen gelagert und durch das Zusammenwirken von Gehäuse und Deckel gesichert ist, wobei sie mindestens in der einen Ausnehmung durch ein als Dichtung ausgebildetes Lager gehalten und durch dieses Lager nach außen geführt ist, wo sie einen Handgriff aufweist.

Durch diese erfindungsgemäße Lösung ist ein Rückstauverschluß geschaffen, welcher ohne komplizierte aufwendige Scharniere auskommt und somit mit einer relativ geringen Anzahl von konstruktiv einfachen und in Material und Herstellung billigen Bauteilen auskommt, welche sehr einfach montiert werden können. Da die Klappenscharniere gebildet werden durch einen Teil der Randdichtung, nehmen diese Scharniere sehr

wenig Platz weg, so daß die Bauhöhe dadurch nicht negativ beeinflußt wird. Das gleiche gilt für die horizontal verlaufende, am Gehäuse oder am Deckel mit Dichtungslagern gelagerte Welle des Schwenkhebels. Durch diese horizontale Anordnung wird wiederum die Bauhöhe gering gehalten.

Vorteilhafterweise kann das Verankerungsteil für die Rückschlagklappen entweder ein die Randdichtung umgebender Ring, der vorzugsweise eine U-förmige Außenkontur hat, oder ein oberhalb der Randdichtung angeordneter horizontaler Steg sein.

Dabei ist die Aufnahme für das Verankerungsteil entweder eine im wesentlichen U-förmige Nut im Gehäuse oder eine Einhängeleiste, seitliche Aufnahmetaschen oder eine Ausnehmung im Deckelansatz, durch welchen das Verankerungsteil am Gehäuse festgelegt wird.

Damit die Rückschlagklappen auch in unbelastetem Zustande leicht gegen den Klappensitz anliegen, ist der Klappensitz leicht zur Lotrechten geneigt angeordne Ferner kann das Verankerungsteil leicht zur Anschlagsebene geneigt angeordnet sein, so daß die Klappe durch die Elastizität des Flachmaterials mit geringem Druck an ihren Sitz angepreßt wird. Dies kann auch erreicht

werden durch eine keilförmige Ausgestaltung des Freiraums zwischen Andrückfläche und Deckelansatz. Dies ist allerdings nur möglich, wenn der Deckel in Längsrichtung des Gehäuses fixiert ist.

Besonders vorteilhaft ist es, wenn die Ausnehmung und das darin aufgenommene Dichtungslager für die Welle des Arretierorgans eine U-förmige Innen- bzw. Außenkontur hat. Dadurch wird gleichzeitig mit der Dichtwirkung nach außen auch eine Dichtwirkung gegen die Deckeldichtung erreicht. Besonders vorteilhaft ist es dabei, wenn der außerhalb des Gehäuses angeordnete Handgriff des Schwenkhebels und der außerhalb des Gehäuses verlaufende Teil der Lagerungswelle des Schwenkhebels einen geringeren Durchmesser haben als die innerhalb des Gehäuses verlaufende Lagerwelle, damit das Dichtungslager von außen auf die Welle aufgeschoben werden kann.

Zum Festhalten des Schwenkhebels in seiner Sperrposition sind vorteilhafterweise Rasten auf der Außenseite des Deckels oder des Gehäuses angeordnet. Auch Rasten für das Festhalten des Schwenkhebels in der Offenstellung können vorteilhaft sein.

Wenn vorteilhafterweise die Ausnehmungen für die Lagerung der Welle am Gehäuse oder am Deckel beide

die gleichen Abmessungen haben und identische Dichtungslager darin aufgenommen sind, kann der Deckel und das Gehäuse (durch Wechselteile in den Spritzformen) in Links- oder Rechtsausführung hergestellt werden. In diesem Falle sind vorteilhafterweise auf beiden Seiten des Deckels bzw. des Gehäuses an einander entsprechenden Stellen Arretierrasten für den Handgriff des Schwenkhebels vorgesehen.

An der Klappe und dem Arretierorgan können miteinander zusammenwirkende Mittel vorgesehen sein zum Abheben der Klappe von ihrem Sitz. Diese Mittel können vorteilhafterweise ein Haken am Ende des Arretierorgans und ein Knipser oder Haken am starren Mittelteil der Klappen sein. In Schließstellung der Klappe hintergreift Haken am Arretierorgan den Knipser an der Klappe und beim Öffnen der Klappe nimmt aufgrund der oberhalb der Schwenkachse der Klappe angeordneten Schwenkachse des Arretierhebels der Haken am Arretierorgan einen anderen Weg als der Knipser oder Haken an der Klappe. Dadurch lösen sich Haken und Knipser beim Öffnen der Klappe selbständig.

Um eine seitliche Verschiebung entlang der Längsachse der Lagerwelle des Schwenkhebels zu verhindern, weist die Welle innerhalb des Gehäuses zwischen Dichtungslager und dem Deckelansatz, der das Verankerungsteil der Klappe

festlegt, einen Bund auf, der durch das Dichtungslager bzw. die Gebäudewandung und den Deckelansatz an seiner Stelle gehalten wird.

Durch die Erfindung ist ein Rückstaudoppelverschluß geschaffen, der mit konstruktiv sehr einfachen Mitteln billig herstellbar ist.

Wenn vorteilhafterweise sowohl die Klappen als auch der Arretierhebel im Deckel eingefügt bzw. gelagert sind, so kann der Deckel mit allen beweglichen Teilen des Rückstaudoppelverschlusses zusammen ein- bzw. ausgebaut werden. Dadurch ist die Montage weiter vereinfacht und zudem ist die Reinigungsfähigkeit erheblich erhöht, da gleichzeitig alle Teile voneinander entfernt werden und somit der Zugriff wesentlich verbessert ist.

Im folgenden wird die Erfindung anhand von Ausführungsbeispielen unter Bezugnahme auf die Figuren näher beschrieben. Es zeigen:

Fig. 1 einen seitlichen Querschnitt einer bevorzugten Ausführungsform;

Fig. 2 eine perspektivische, teilweise weggebrochene

Ansicht einer weiteren Ausführungsform;

Fig. 3 eine Draufsicht auf eine Rückstauklappe mit Dichtfläche und U-förmigem Verankerungsteil;

Fig. 4 eine geschnittene Teilansicht des Rückstauverschlusses, welche die Festlegung des Verankerungsteils zeigt;

Fig. 5 eine Schnittansicht einer bevorzugten Ausführungsform des Rückstauverschlusses;

Fig. 6 eine Detailansicht der Lagerausnehmungen für die Welle des Arretierhebels;

Fig. 7 eine Schnittansicht zur Erläuterung einer bevorzugten Form der Festlegung des Verankerungsteils der Klappe;

Fig. 8 eine Teilansicht einer weiteren erfindungsgemäßen Ausführungsform des Verschlusses;

Fig. 9 eine Teilansicht des Deckels mit den Arretierrasten für den Schwenkhebel;

Fig. 10 eine teilweise Schnittansicht einer weiteren Ausführungsform, bei der das Arretierorgan im Deckel gelagert ist; und

Fig. 11 einen Schnitt entlang der Schnittlinie XI-XI der Fig. 10.

Der in Fig. 1 gezeigte Rückstaudoppelverschluß besteht aus einem Gehäuse 10, welches mit einem Stutzen 12 verbunden ist, der an eine Entwässerungsleitung, z.B. eines Gebäudes, angeschlossen werden kann. Auf der anderen Seite des Gehäuses 10 ist ein Ablaufstutzen 14 gezeigt, durch den das Abwasser wieder ablaufen kann. Das Gehäuse des Verschlusses ist durch zwei Klappen 20 und 22 und die Schottwand 64 in zwei Kammern 16 und 18 aufgeteilt. Die Klappen 20 und 22 sind an der Oberseite des Gehäuses schwenkbar gelagert auf eine Weise, die im folgenden noch beschrieben werden wird.

In Schließstellung liegen die Klappen 20 und 22 an Gehäusestufen 15 und 17 und der Schottwand 64 bzw. der Endfläche des Gehäuses 10 an.

Wenn Abwasser in das Gehäuse 10 einläuft, so werden nacheinander die Klappen 20 und 22 unter dem Druck des

zufließenden Wassers hochgeschwenkt.

Fließt kein Abwasser mehr zu, so fallen die Rückstauklappen aufgrund ihres Eigengewichts wieder herunter auf ihren Klappensitz 15, 64, 17. Damit die Klappen mit einem gewissen Druck auf ihrem Klappensitz aufliegen, ist in. Fig. 1 der Klappensitz leicht zur Vertikalen geneigt. Die erste Klappe 20 ist zusätzlich durch ein Gewicht 51 besch das von einem unteren Haken 53 und einem oberen Knipser 4 gehalten wird.

Im Falle eines Rückstaus des Abwassers, d.h. eines Abwasserflusses in Fig. 1 von rechts nach links, werden durch den Druck des zufließenden Wassers die Klappen 22 und 20 fest auf ihren Sitz gedrückt, so daß kein rückgestautes Abwasser über den Stutzen 12 in die Abwasserleitung zurückfließen kann.

Die Klappen 20 und 22 in Fig. 1 sind identisch ausgestaltet. Sie bestehen jeweils aus einem starren Mittelteil 28, 30, welches ein Kunststoff-Formteil ist und einen hinterschnittenen Kragen 32, 34 aufweist. Dieser Kragen 32, 34 wird hintergriffen von einem entsprechend ausgeschnittenen Dichtungsteil, welches aus Flachmaterial aus einem elastomeren Material besteht. Dieses Dichtungsmaterial bildet im wesentlichen eine ringförmige Randdichtung für das starre Mittelteil, welche sich in Schließstellung der Klappe auf den Klappensitz anschmiegt

und diesen unter Druck abdichtet. Die Randdichtung 24 bzw. 26 weist in ihrem oberen Teil einen Scharnierbereich 36, 38 auf, der den Übergang zwischen Dichtungsteil und Verankerungsteil des Flachmaterials bildet. Der oberhalb des Scharnierteiles 36, 38 liegende Teil des Flachmaterials ist in der Ausführungsform von Fig. 1 als Steg ausgebildet, der im wesentlichen die Länge der Breite des Gehäuses 10 hat und in seitlichen Aufnahmetaschen (nicht gezeigt) der Seitenwandung des Gehäuses 10 von oben eingeschoben ist.

Dieser als Verankerungsteil dienende Steg wird in die Aufnahmetaschen eingehängt, bevor der Deckel 50 auf dem Gehäuse aufgebracht wird. Die seitlichen Aufnahmetaschen im Gehäuse haben den Zweck, das Verankerungsteil und die daran hängende Klappe 20 bzw. 22 am Gehäuse örtlich zu fixieren.

Am Deckel 50 sind auf der Unterseite an geeigneter Stelle Ansätze 40 und 42 vorgesehen, die beim Einbau des Deckels das Verankerungsteil für die Klappe übergreifen und unter Druck als Klemmansatz sichern.

Der Deckel 50, der Versteifungsrippen 56 aufweist, ist im eingebauten Zustand mit dem Gehäuse 10 über die Dichtung 54 druckdicht verbunden.

Im Abstand über dem Klappenscharnier 36 der festlegbaren Klappe 22 ist eine Welle 46 horizontal angeordnet. Diese Welle ist in Fig. 1 am Gehäuse in Ausnehmungen an der Seitenwand drehbar und dicht gelagert. An der schwenkbaren Welle 46 ist ein Arretierhebel 44 starr verbunden, der an seinem von der Welle 46 abgewandten Ende einen Haken 47 aufweist.

An der Welle 46 ist in dem Bereich, der außerhalb des Gehäuses 10 verläuft, ein Handgriff 48 befesti der zur Betätigung des Arretierhebels 44 von außen dien Wenn der Handgriff 48 in Fig. 1 nach oben bewegt wird, so schwenkt der Arretierhebel 44 in der Kammer 18 des G häuses 10 nach unten.und das Hakenteil 47 kommt in mech nischen Eingriff mit dem pilzförmigen Knipserteil 49 am starren Mittelteil 28 der Klappe 22. Wenn der Handgriff 48 durch geeignete Rasten am Deckel 50 in seiner Schließstellung arretiert wird, so ist gleichzeitig über den Arretierhebel 44 das starre Mittelteil 28 und damit die Klappe 22 in ihrer Schließstellung fixiert.

Wenn sich der Rückstauverschluß in dieser Sperrstellung befindet, so kann über eine Öffnung 52 im Deckel 50 die Kammer 16 des Rückstauverschlusses mit Druck beaufschlagt werden, um die Randdichtungen 24 und 26 der Klappen 20 und 22 auf Dichtigkeit zu prüfen.

Ferner kann durch das Versperren der Klappe 22 jeglicher Durchfluß von Abwasser durch das Gehäuse 10 verhindert werden.

Wenn der Arretierhebel 44 durch Betätigung des Handgriffs 48 wieder aus seiner Schließstellung gebracht wird, so nimmt der Hakenteil 47, der den Knipserteil 49 hintergreift, diesen Knipserteil mit und reißt dadurch die Klappe 22 von ihrem Sitz 15, 64 ab, so daß diese wieder freigängig ist. Im weiteren Verlauf der Schwenkbewegung des Arretierhebels 44 im Gegenuhrzeigersinn in Fig. 1 löst sich der Hakenteil 47 vom Knopf 49 automatisch, da die Schwenkachse, d.h. die Welle 46 des Arretierhebels 44, schräg oberhalb des Scharnierbereiches 36 der Klappe 22 liegt, so daß Hakenteil 47 und Knipserteil 49 unterschiedliche Schwenkwege haben.

Dadurch ist es auf sehr einfache Weise möglich, die eventuell durch aufgetretenen Rückstau festgesetzte Klappe 22 von außen wieder frei beweglich zu machen, d.h. ohne daß der Deckel hierfür geöffnet werden muß.

Fig. 2 zeigt eine perspektivische Teilansicht einer anderen Ausführungsform des erfindungsgemäßen Rückstauverschlusses. In dieser Ausführungsform ist das starre

Mittelteil 28 der Klappe 22 aufgenommen in einem Dichtungsring 24, der über den Scharnierbereich 36 mit einem Verankerungsteil 60 verbunden ist, welches eine U-förmige Außenkontur hat und als Ring den Dichtring bzw. die Klappe umgibt.

Das Verankerungsteil 60 ist in einer U-förmigen Nut angeordnet, die gebildet wird aus einem U-förmigen Steg 62 und der Schottwand 64 bzw. der (in Fig. 2 nicht gezeigten) Gehäusestufe 15.

Da das Verankerungsteil 60 mit dem Dichtring 24 der Klappe 22 einstückig ausgebildet ist und das Verankerur teil 60 an der Schottwand 64, d.h. in der Anschlagebene der Klappe liegt, liegt auch automatisch die ringförmig Randdichtung der Klappe 22 genau in der Anschlagebene und bedarf keiner weiteren Justierung.

Am oberen Rand des Gehäuses 10 ist in Fig. 2 eine Ausnehmung 68 gezeigt, die zur Aufnahme einer U-förmige Lagerdichtung für die Welle 46 dient. Diese Ausnehmung verläuft in einem hinterschnittenen U-förmigen Kragen 6 der einstückig mit der Gehäusewandung 10 gegossen oder gespritzt sein kann.

Fig. 3 zeigt in der Draufsicht noch einmal die Klappe 22 mit ihrem U-förmigen Verankerungsteil 60, welches beim Einbau der Klappe von oben in die U-förmige Nut von Fig. 2 eingeschoben wird. Der oberhalb und neben dem Scharnierbereich 36 liegende Teil des Verankerungsteils wird durch den am Deckel ausgeformten Ansatz an der Schottwand 64 angepreßt und somit gegen jedes Verschieben oder Verrutschen gesichert.

Fig. 4 zeigt eine besondere Ausgestaltungsform dieses Klemmansatzes 40 am Deckel 50. In diesem Falle ist das Verankerungsteil kein U-förmiger Ring um die Klappe herum, sondern nur ein horizontal verlaufender Steg 70, der über den Scharnierbereich 36 mit der Klappe 22 verbunden ist. Beim Einbau der Klappe wird dieser Steg 70 auf zwei seitlichen Einhängeleisten 72 an der Schottwand 64 eingehängt und dadurch positioniert. Beim Anbau des Deckels 50 legt dann der Ansatz 40 das Verankerungsteil 70 gegen die Schottwand 64 unverrückbar fest.

Dabei kann es von Vorteil sein, wenn der Ansatz 40 auf seiner dem Verankerungsteil zugewandten Seite eine Schrägfläche 74 hat, die eine von der Schottwand 64 abweichende Neigung aufweist. Dadurch wird auf das Verankerungsteil 70 eine Art Keilwirkung ausgeübt, welche ein

leichtes Andrücken der Klappe auf ihren Sitz bewirkt. In diesem Falle muß der Deckel 50 gegen eine Verschiebung in Längsrichtung des Gehäuses unter Einwirkung des Einklemmens durch weitere Ansätze gesichert sein.

Es kann aber auch die Schottwand 64 im Aufnahmebereich für das Verankerungsteil 70 steiler nach oben geneigt sein und der Ansatz 40 eine entsp. chend geneigte Fläche 74 aufweisen, so daß das Verankerungsteil beim Einbau des Deckels 50 unter einem anderen Winkel festgelegt wird, als die Klappe selber. Dadurch kann aufgrund der leichten Verbiegung des Scharnierteils 36 und der Rückstellkraft des elastomeren Materials bewirkt werden, daß die Klappe mit sanftem Druck gegen ihren Sitz angepreßt wird.

Fig. 5 zeigt eine weitere Ausführungsform des Rückstauverschlusses. Fig. 5 ist eine Schnittansicht mit Blick entgegen der Abflußrichtung bzw. in Rückstaurichtung.

In dieser Ausführungsform ist die Klappe 22 wiederum durch das stegförmige Verankerungsteil 70 am Gehäuse

festgelegt. In diesem Falle ist das Verankerungsteil 70 nicht auf zwei Einhängeleisten 72, sondern in einer Nut 41 im Deckelansatz 40 festgelegt. Dies ist in Fig. 7 genauer dargestellt.

In Fig. 5 ist die Lagerung der Welle 46 des Arretierhebels 44 genauer gezeigt. Die Welle ist beidseitig an der Gehäusewandung 10 gelagert. Auf der Seite, wo die Welle in den Handgriff 48 übergeht, ist sie über eine in Fig. 6 genauer gezeigte U-förmige Lagerdichtung 76 in einer Ausnehmung 68 in der Gehäusewandung 10 so gelagert, daß sie über den Handgriff 48 gedreht werden kann. Das Dichtungslager 76 hat U-förmige Außenkontur und ist in einer entsprechenden Ausnehmung im Vorsprung 66 angeordnet. Die Oberseite des U's steht etwas über die Oberkante des Gehäuses 10 vor und kommt beim Anbau des Deckels 50 in dichtendem Eingriff mit der Deckeldichtung 54.

Auf der anderen Seite ist die Welle 48 mit einem Bund 80 in einer Ausnehmung 78 in der Gehäusewandung 10 gelagert.

Von besonderem Vorteil ist es, wenn die Lagerausnehmungen 66 und 78 gleiche Abmessungen haben. Dann ist es nämlich möglich, beim Spritzguß des Gehäuses

durch Austauschen von Wechselteilen in der Spritzgußform mit im wesentlichen der gleichen Spritzgußform eine Rechts- und eine Linksausführung des Gehäuses bzw. ggf. auch des Deckels herzustellen. In einer spiegelsymmetrischen Ausführungsform des Rückstauverschlusses von Fig. 5 wäre dann der nach außen verlaufende Teil der Welle 46 rechts angeordnet und die Aufnahme 78 würde eine Öffnung nach außen aufweisen.

Auf dem zum Handgriff zeigenden Teil weist die Welle 46 einen Bund 82 auf. Dieser Bund ist derartig angeordnet, daß er nach dem Einbau der Welle zwischen der Gehäusewandung bzw. dem Lager 66 und dem Deckelansatz 40 liegt. Auf diese Weise wird verhindert, daß sich die Welle 46 seitlich verschieben kann, da sie sonst gegen das Gehäuse (links) bzw. den Deckelansatz (rechts) stoßen würde.

In Fig. 5 ist links am Deckel eine Raste 86 gezeigt, welche den Handgriff 48 des Arretierhebels 44 ggf. in Schließstellung arretieren kann. Die gleiche Raste 86 ist auf der rechten Seite des Deckels 50 angeordnet, für den Fall, daß die spiegelsymmetrische Form des Gehäuses 10 verwendet werden soll.

Das Verankerungsteil 70 wird vor dem Anbau des Deckels 50 in die Nut 41 (Fig. 7) am Ansatz 40 eingelegt und mit dem Deckel zusammen eingebaut. Beim Einbau legt sich das Verankerungsteil 70 gegen die Schottwand 64 und wird so zwischen Schottwand und Deckelansatz festgelegt. Dadurch können Klappe und Deckel gemeinsam in einem Stück eingebaut werden.

Fig. 8 zeigt eine weitere Ausführungsform des Rückstaudoppelverschlusses. In dieser Ausführungsform ist wiederum das Verankerungsteil von Fig. 3 verwendet, welches von einer Nut aufgenommen wird, die durch den Steg 62 und die Schottwand 64 bzw. die Gehäusestufe 15 gebildet wird.

Der Arretierhebel 44 dieser Ausführungsform hat ein Hakenende 47', welches etwas anders ausgeführt ist als die Ausführungsform von Fig. 1. Ebenso ist der Knopf 49 in Fig. 1 ersetzt durch ein Hakenteil 49', welches mit dem Hakenteil 47' in Schließstellung des Hebels in Eingriff kommt.

Fig. 9 zeigt den Deckel 50 mit seinen Arretierrasten 86 und dem Handgriff 48 in Sperrstellung in Draufsicht.

Fig. 10 zeigt eine weitere Ausführungsform der Erfindung.

In dieser Ausführungsform ist die Lagerausnehmung für die Welle 46 des Arretierhebels 44 im Deckel 50 des Gehäuses angeordnet. In der Ausnehmung 66' im Deckel 50 ist eine Lagerdichtung 76 angeordnet, die im wesentlichen die gleiche U-Form hat wie in den vorangegangenen Ausführungsformen.

In der Ausführungsform von Fig. 11, die partiell der von Fig. 10 entspricht, ist außer der Welle 46 auch die Klappe 22 am Deckel gelagert. Dies geschieht in der Ausführungsform von Fig. 7 entsprechender Weise durch Vorsehen einer Nut oder Ausnehmung 41 im Deckelansatz 40. Auf diese Weise können Klappe, Deckel und Arretierorgan in einem Arbeitsgang am Gehäuse 10 angebaut werden.

Die Ausnehmungen für die Lagerdichtung 76 bzw. 76' sind in dieser Ausführungsform auf beiden Seiten identisch in ihren Abmessungen, so daß identische Dichtungslager darin untergebracht werden können.

Es ist zu sehen, daß in dieser Ausführungsform, bei der die Welle im Deckel gelagert ist, natürlich die Deckeldichtung 54 unterhalb der Dichtungslager 76 und 76' angeordnet sein muß. Ansonsten wirken die Dichtungslager 76 und 76' in gleicher Weise mit der Deckeldichtung 54 zusammen wie in den anderen Ausführungsformen.

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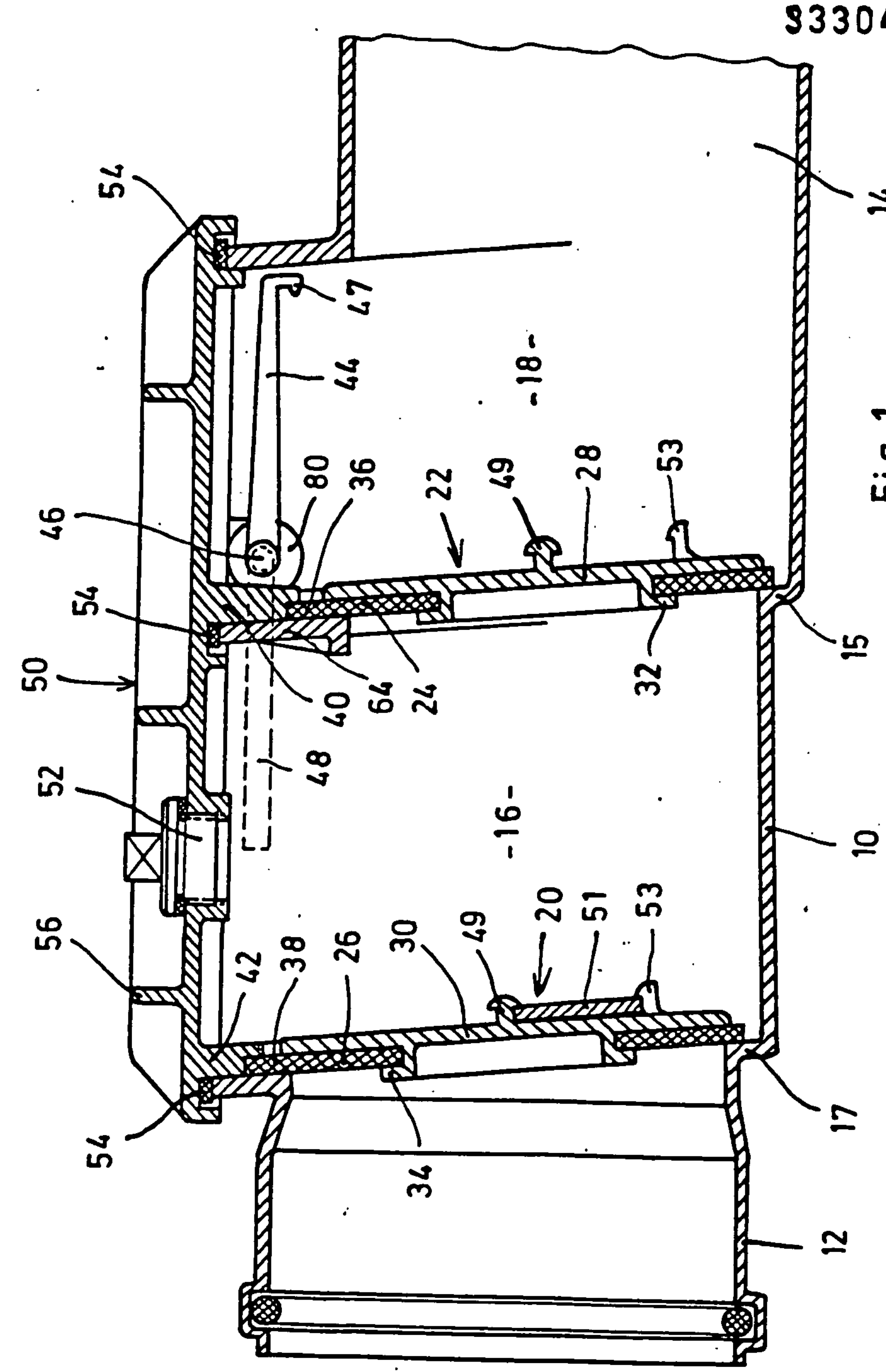
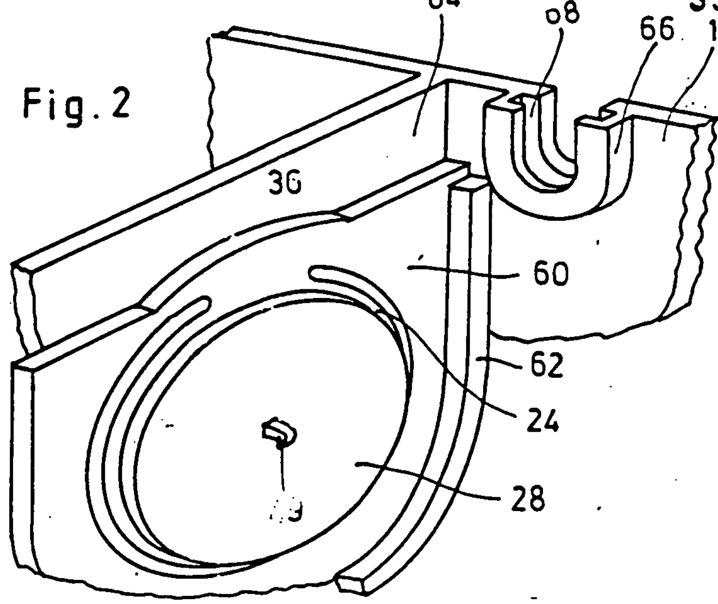


Fig.1

Fig. 2



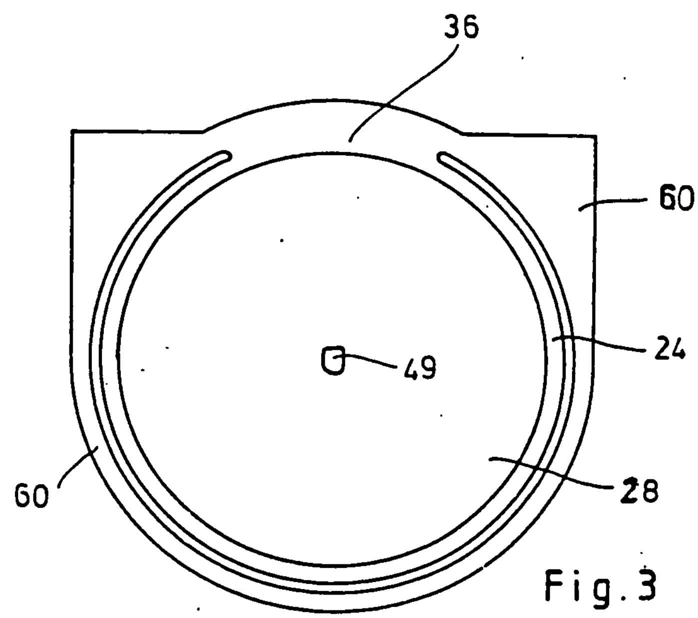


Fig. 3

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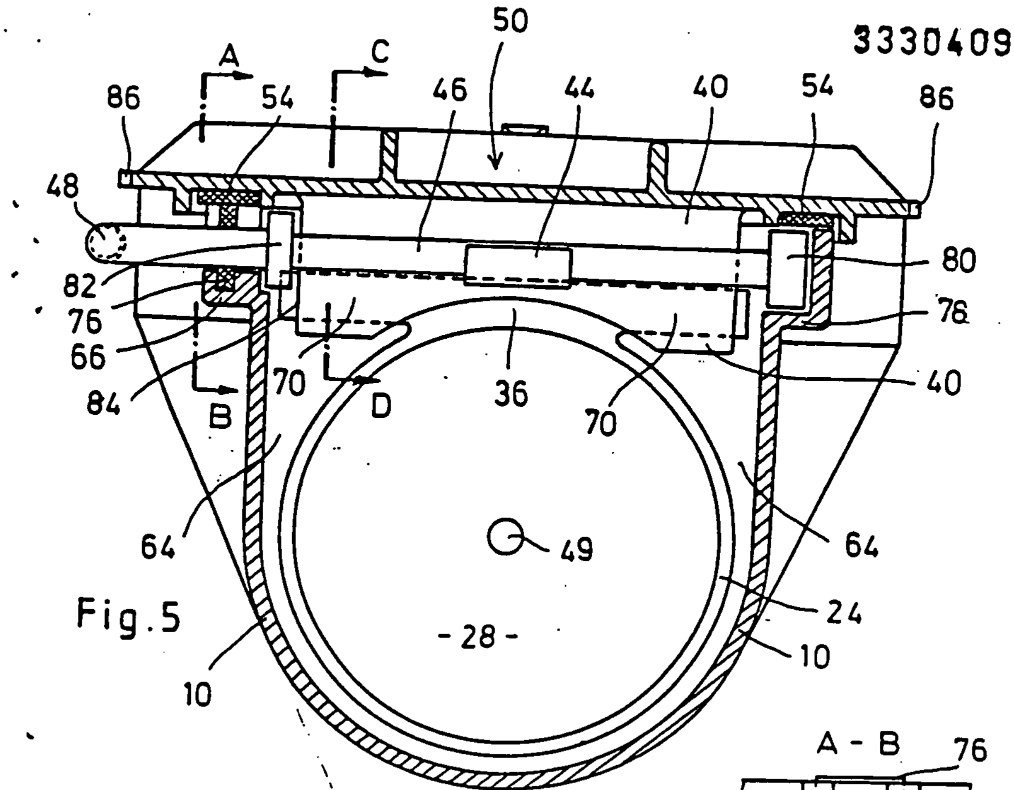

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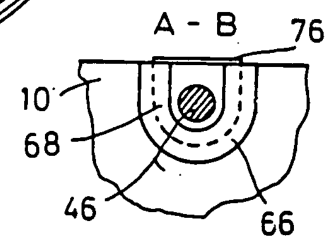


Fig. 6

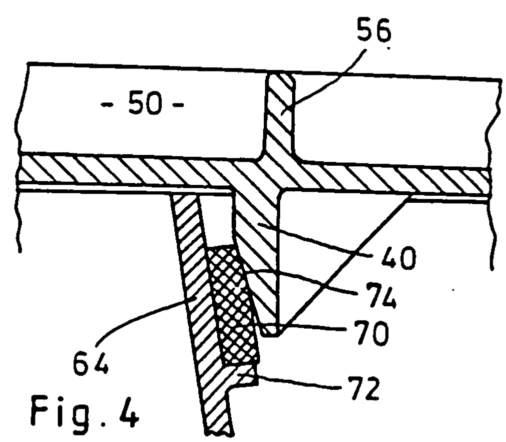


Fig. 4

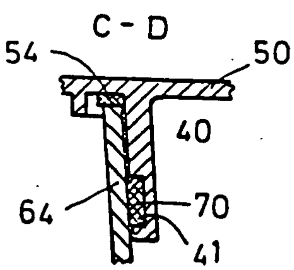


Fig. 7

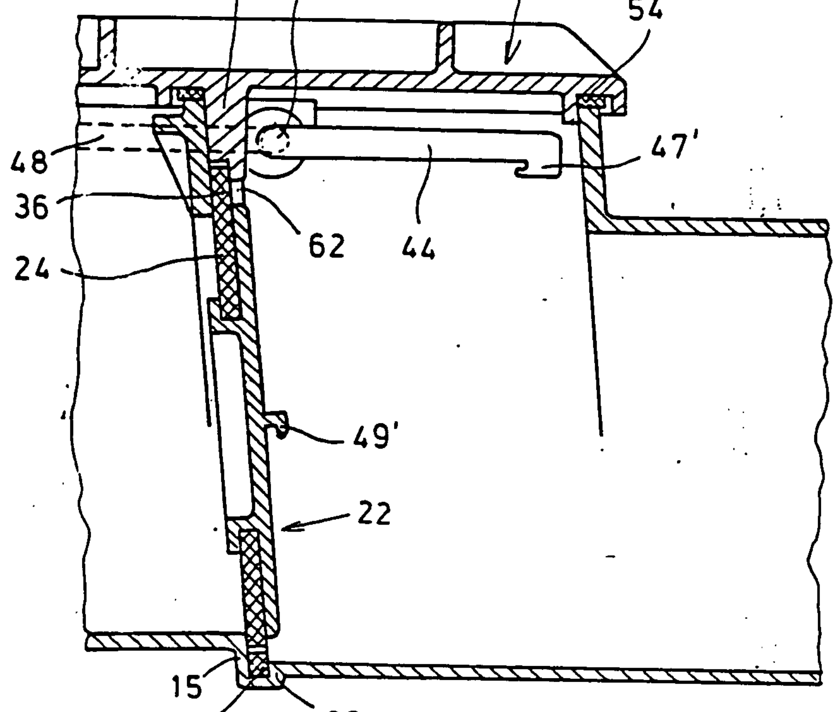


Fig.8

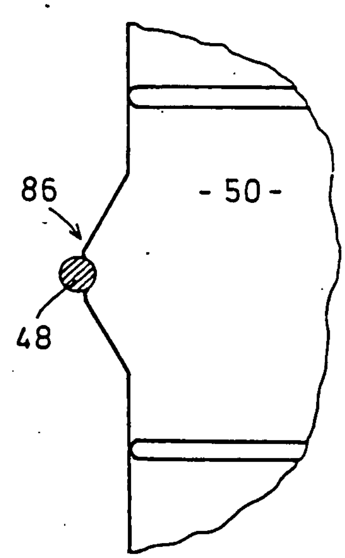


Fig.9

PASE ★ Q66 85-069239/12 ★DE 3330-409-A

Dewatering pipe double reflux valve - has flat seals each with hinging integral protruding anchoring portion

PASSAVANT-WERKE AG 23.08.83-DE-330409

(14.03.85) F16k-01/18

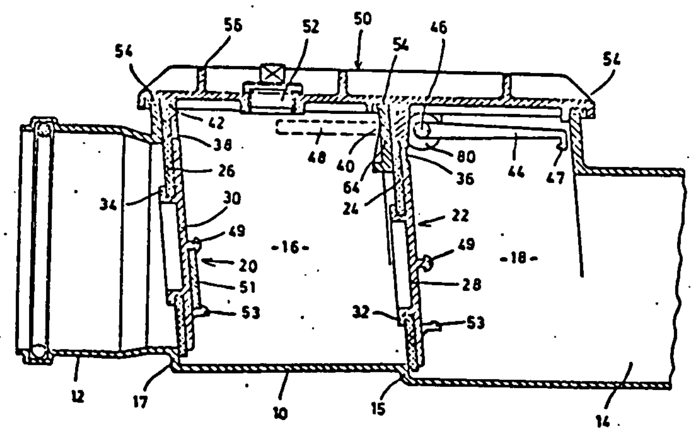
23.08.83 as 330409 (160DB)

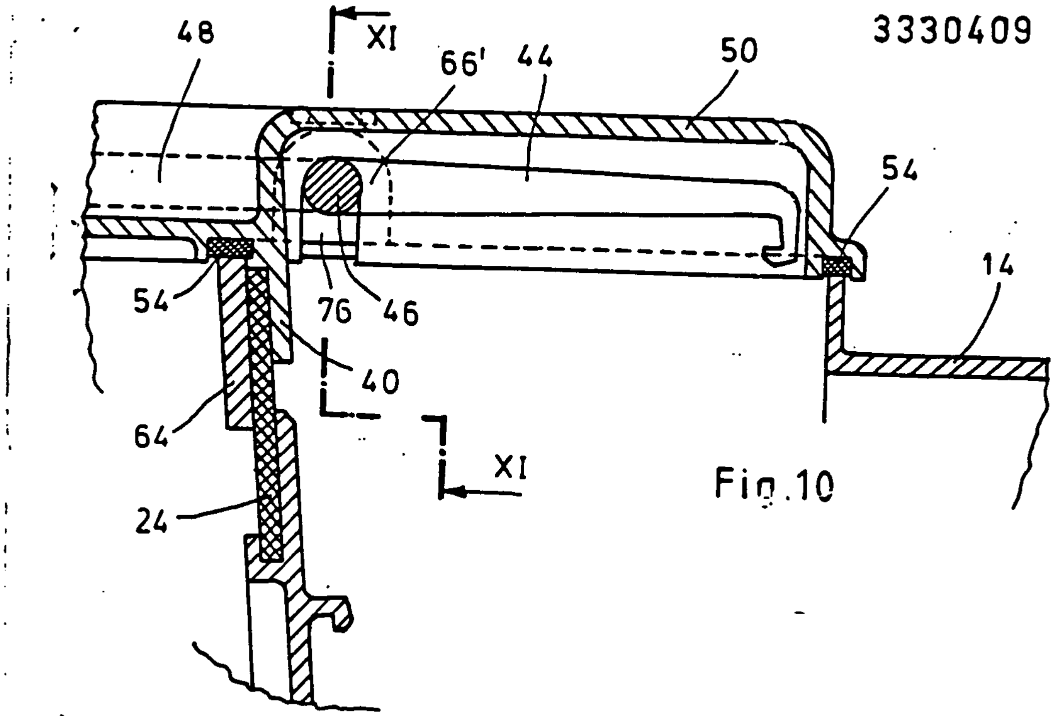
The double reflux valve for a dewatering pipe comprises a housing with cover containing two flaps, each consisting of a rigid central portion and an annular elastomer edge seal, shutting under gravity in the reverse flow direction. A locking device engaging with the rigid portion of one flap and actuated from outside holds it shut.

The seal (24,26) on each flap (20,22) is of flat material, and has at the top an integral protruding anchoring section on both sides in the plane of the flap, to which it is joined by a hinge portion (36,38). This section fits in a mounting in the cover (50) or housing (10) and is secured by a protrusion (40) on the former to the housing. The locking device is a lever (44) on a horizontal shaft (46) above the level of the hinge portion and secured in recesses in housing and cover, one of which forms a sealed bearing through which it extends to an external handle (48).

ADVANTAGE - Compactness, and simple construction and assembly. (13pp Dwg.No.1/11)

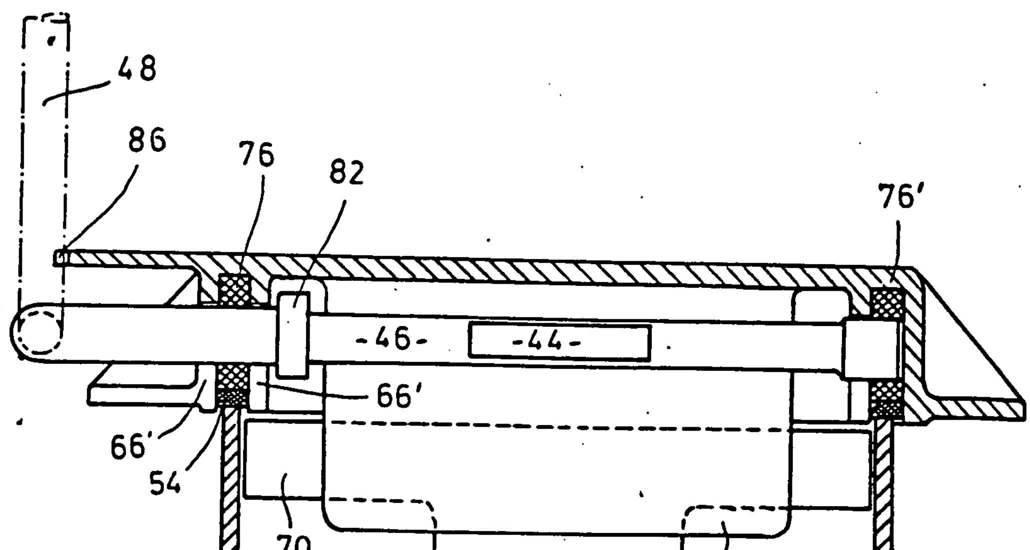
N85-051687





XI
48
66'
44
50
54
14
54
76
46
40
64
24
XI

Fig.10



48
86
76
82
76'
-46-
-44-
66'
66'
54
70
40

Fig.11

Rank(R) R 1 OF 1 Database WPIL Mode Page

XRPX Acc No: N85-202065
Angularly adjustable elbow pipe joint has two halves flange-connected on inclined parting plane and rotatable for angle adjustment
Index Terms: ANGULAR ADJUST ELBOW PIPE JOINT; TWO HALVES FLANGE CONNECT INCLINE PART PLANE ROTATING ANGLE ADJUST
Patent Assignee: (PASE) PASSAVANT-WERKE AG
Author (Inventor): PEINING H P
Number of Patents: 001
Patent Family:

CC Number	Kind	Date	Week	
DE 3414077	A	851024	8544	(Basic)

Priority Data (CC No Date): DE 3414077 (840413)
Abstract (Basic): DE 3414077

The adjustable elbow pipe joint comprises two halves (1,2) which form an inlet (7) and an outlet (14) connection. These are connected along an inclined parting plane (8) via roundflanges (3,4) rotationally adjustable relative to one another to provide an angled or a through connector.

At least one half (1; 7,9) has a tubular inlet (7) with transition into a larger-dia. portion (9) which contains a swivellable closure member (12) capable of seating on a seat (7'). The member may be integral with an annular carrier (10) consisting of flexible plastics.

ADVANTAGE - Check valve is integrated in the pipe joint and operates in any angular position. @(21pp Dwg.No.1/13)@

Derwent Class: Q42; Q66; Q67;
Int Pat Class: E03C-001/10; F16K-015/16; F16K-027/00; F16L-027/00; F16L-043/00

e. 10667 -1- F16k27/02H

(19) BUNDESREPUBLIK DEUTSCHLAND

DEUTSCHES PATENTAMT

(12) **Offenlegungsschrift**

(11) **DE 3414077 A1**

(51) Int. Cl. 4: **F 16 K 27/00**
F 16 K 15/16
F 16 L 43/00
~~F 03 C 1/10~~
F 16 L 27/00

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(43) Offenlegungstag: 24. 10. 85

DE 3414077 A1

/ F16k15/14H
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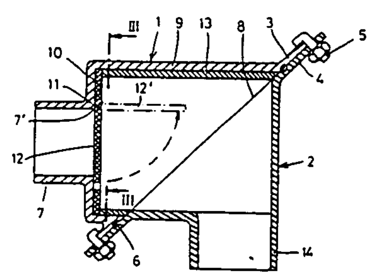
DE-PS	5 03 301
FR	14 74 662
FR	3 67 196
GB	6 95 693
GB	2 88 845
US	37 62 438
US	32 84 106
US	26 76 609
US	22 27 767
EP	00 94 549

(54) Winkelveränderbares Kniestück

Winkelveränderbares Kniestück mit zwei ein Einlaufstück und ein Ablaufstück bildenden Gehäusehälften, die an einer im Winkel zur Achse jeder Gehäusehälfte geneigten Trennebene mit kreisrunden Flanschen aneinander anliegen und verdrehbar miteinander verbunden sind, wobei mindestens eine Gehäusehälfte im wesentlichen rohrförmig mit einer zur Trennebene hin gerichteten Querschnittserweiterung ausgebildet ist, mit mindestens einer schwenkbaren Rückschlagklappe (12), die gegen einen Klappensitz schließt und derart angeordnet ist, daß ihr Schwenkbereich innerhalb der Querschnittserweiterung entweder des Einlaufstücks (1) oder des Ablaufstücks (2) liegt.



DE 3414077 A1

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Winkelveränderbares Kniestück

MÜNCHEN
A 08 P/G 1232

Patentansprüche

1. Winkelveränderbares Kniestück mit zwei, ein Einlaufstück und ein Ablaufstück bildenden Gehäusehälften, die an einer im Winkel zur Achse jeder Gehäusehälfte geneigten Trennebene mit kreisrunden Flanschen aneinander anliegen und verdrehbar miteinander verbunden sind, wobei mindestens eine Gehäusehälfte im wesentlichen rohrförmig mit einer zur Trennebene hin gerichteten Querschnittserweiterung ausgebildet ist, dadurch gekennzeichnet, daß im Kniestück mindestens eine schwenkbare Rückschlagklappe (12), die gegen einen Klappensitz schließt, derart angeordnet ist, daß der Schwenkbereich der Klappe innerhalb der Querschnittserweiterung entweder des Einlaufstücks (1) oder des Ablaufstücks (2) liegt.

2. Kniestück nach Anspruch 1, dadurch gekennzeichnet, daß die Klappe (12) in einem ringförmigen Klappenträger (10) schwenkbar angeordnet ist.

3. Kniestück nach Anspruch 1, dadurch gekennzeichnet, daß die Klappe (12) mit dem aus flexiblem Kunststoffmaterial bestehenden Klappenträger (10) durch teilweises Ausstanzen einstückig ausgebildet ist.

4. Kniestück nach Anspruch 1, dadurch gekennzeichnet, daß das Einlaufstück (1) eine stufenartige Querschnittserweiterung zwischen einem Einlaufrohr (7) und einem anschließenden erweiterten Gehäuseabschnitt (9) aufweist, und daß die Klappe (12) an der stufenartigen Querschnittserweiterung angeordnet ist, an dieser als Klappensitz anliegt und sich in den erweiterten Gehäuseabschnitt (9) des Einlaufstücks (1) hinein öffnet.

5. Kniestück nach Anspruch 1, dadurch gekennzeichnet, daß die Klappe (22) in der Trennebene (8) des Kniestücks angeordnet ist und sich in die Querschnittserweiterung des Ablaufstücks hinein öffnet.

6. Kniestück nach Anspruch 2, dadurch gekennzeichnet, daß der Klappenträger (10) mittels eines in den erweiterten Gehäuseteil (9) des Einlaufstücks (1) eingesetzten rohrförmigen Druckstücks (13) in Anlage an einer

Ringschulter des Kniestücks oder an einem zweiten Druckstück (24) in Anlage gehalten und dadurch fixiert ist.

7. Kniestück nach Anspruch 6 , dadurch g e k e n n - z e i c h n e t , daß das oder jedes Druckstück (13, 24) mit einem Flansch (19, 19') in der Trennebene (8) zwischen die Flansche (18) des Einlaufstücks (1, 15) und Ablaufstücks (2, 15) greift.

8. Kniestück nach Anspruch 1 , dadurch g e k e n n - z e i c h n e t , daß im Kniestück zwei Rückschlagklappen (12, 22) angeordnet sind, von denen die eine (12) im Einlaufstück an der Einmündung von dessen Einlaufrohr (7) und die andere (22) in der Trennebene (8) zwischen Einlaufstück und Ablaufstück liegt.

9. Kniestück nach Anspruch 8 , dadurch g e k e n n - z e i c h n e t, daß die Klappenträger (10, 23) beider Klappen (12, 22) durch ein im Einlaufstück eingesetztes rohrförmiges Druckstück (13) fixiert sind, an dem auch ein Klappensitz für die in der Trennebene (8) liegende Klappe (22) ausgebildet ist.

10. Kniestück nach Anspruch 1, 2 und 3 , dadurch g e - k e n n z e i c h n e t , daß das Druckstück (13) rohrförmig konzentrisch im Einlaufstück (1) sitzt und in der

Trennebene (8) bündig an der Stirnfläche des Ablaufstücks (2) anliegt, wobei der Innendurchmesser des Ablaufstücks (2) gleich dem Innendurchmesser des Druckstücks (13) und um die doppelte Wandstärke des Druckstücks kleiner als der Innendurchmesser des Einlaufstücks (1) ist.

11. Kniestück nach Anspruch 1 bis 5 , dadurch g e k e n n z e i c h n e t , daß das Einlaufstück und das Ablaufstück als identische Rohrabschnitte (15) ausgebildet sind.

12. Kniestück nach Anspruch 10 , dadurch g e k e n n z e i c h n e t , daß im Ablaufstück ein zweites Druckstück (24) angeordnet ist.

13. Kniestück nach Anspruch 1 , dadurch g e k e n n z e i c h n e t , daß das Einlaufrohr (7) am Einlaufstück (1) mittig und das Ablaufrohr (14) am Ablaufstück (2) exzentrisch angeordnet ist.

14. Kniestück nach Anspruch 1 , dadurch g e k e n n z e i c h n e t , daß die beiden Rohrabschnitte (1 und 2) mit gerader Achse ausgebildet sind und die jeweiligen Gehäuse so dimensioniert sind, daß die Klappe (12) bis zu einem Öffnungswinkel von 45° schwenken kann.

15. Kniestück nach Anspruch 1 , dadurch g e k e n n - z e i c h n e t , daß die beiden Rohrabschnitte (26, 27) eine Krümmerform aufweisen.

16. Kniestück nach Anspruch 14 , dadurch g e k e n n - z e i c h n e t , daß das Einlaufstück (26) mit einer Tasche (34) zur Aufnahme der Klappe (32) im geöffneten Zustand versehen ist.

17. Kniestück nach Anspruch 14 , dadurch g e k e n n - z e i c h n e t , daß die Klappe (32) in ihrer Schließlage mittels eines Hebelarmes (33) feststellbar ist.

18. Kniestück nach Anspruch 14 , dadurch g e k e n n - z e i c h n e t , daß die Klappe (32) von Hand betätigbar ist.

19. Kniestück nach Anspruch 17 oder 18, dadurch g e - k e n n z e i c h n e t , daß der Hebelarm (33) eine Drehachse (31) aufweist, die in der Trennebene (8) nach außen abdichtend gelagert ist.

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A 08 / P/G 1232

Winkelveränderbares
Kniestück

Beschreibung

Die Erfindung betrifft ein winkelveränderbares Kniestück mit zwei, ein Einlaufstück und ein Ablaufstück bildenden Gehäusehälften, die an einer im Winkel zur Achse jeder Gehäusehälfte geneigten Trennebene mit kreisrunden Flanschen aneinander anliegen und verdrehbar miteinander verbunden sind, wobei mindestens eine Gehäusehälfte im wesentlichen rohrförmig mit einer zur Trennebene hin gerichteten Querschnittserweiterung ausgebildet ist.

Ein derartiges Kniestück ist durch die DE-PS 27 33 571 bekannt, und wird insbesondere in Verbindung mit Gehäusen, wie Abläufen, Hebeanlagen, Reinigungsrohren u.dgl. verwendet. Durch die Anwendung eines Verstellknies bei solchen

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Armaturen können vorteilhafterweise zwei von drei Modellen eingespart werden. Bei vielen der vorstehend genannten Armaturen sind Rückflußverhinderer notwendig, die zumeist entweder im Einlauf- oder Abflußrohr des Verstellknies angeordnet sind. D.h., es ist ein zusätzliches Bauteil erforderlich, wodurch die Armatur verteuert wird.

Aufgabe der Erfindung ist es, einen derartigen Rückflußverhinderer in einem Verstellknie der eingangs genannten Art zu integrieren, ohne die Verstellfunktion des Verstellknies zu beeinträchtigen, wobei das Verhindern des Rückflusses in jeder Stellung des Verstellknies gewährleistet sein soll.

Diese Aufgabe wird erfindungsgemäß gelöst durch ein winkelveränderbares Kniestück der eingangs genannten Art, das dadurch gekennzeichnet ist, daß im Kniestück mindestens eine schwenkbare Rückschlagklappe, die gegen einen Klappensitz schließ, derart angeordnet ist, daß der Schwenkbereich der Klappe innerhalb der Querschnittserweiterung entweder des Einlaufstücks oder des Ablaufstücks liegt. Zweckmäßigerweise ist die Klappe in einem scheibenförmigen Klappenträger angeordnet, der mittels eines insbesondere rohrförmigen Druckstückes zwischen den Rohrabschnitten gehalten ist. Auf diese Weise kann die Klappe unabhängig von der Winkel-

stellung des Kniestückes immer so angeordnet werden, daß ihre gewünschte Funktion einwandfrei gesichert ist.

Weitere vorteilhafte Ausgestaltungen des erfindungsgemäßen Kniestückes sind den Unteransprüchen 4 bis 19 zu entnehmen.

Ausführungsformen der Erfindung werden anhand der folgenden Figuren im einzelnen beschrieben. Es zeigt :

Fig. 1 und 2 eine Ausführungsform eines Kniestückes in der 0°- und 90°-Stellung, in der Seitenansicht im Schnitt;

Fig. 3 einen Schnitt entlang der Schnittlinie III-III gemäß Fig. 1;

Fig. 4 bis 7 eine andere Ausführungsform eines Kniestückes in 0°- und 90°-Stellungen in der Seitenansicht im Schnitt;

Fig. 8 bis 11 eine weitere Ausführungsform eines Kniestückes in 0°- und 90°-Stellungen in der Seitenansicht im Schnitt;

Fig. 12a und 12b eine weitere Ausführungsform eines Kniestückes in der Seitenansicht im Schnitt und im Schnitt entlang der Schnittlinie B-B;

Fig. 12c eine Einzelheit im Schnitt entlang der Schnittlinie C-C gemäß Fig. 12b; und

Fig. 13a und 13b eine Abwandlung der Ausführungsform gemäß der Fig. 12a und 12b.

Die in den Figuren 1 - 3 gezeigte Ausführungsform eines Kniestückes besteht aus einem Einlaufstück 1 und einem, mit diesem in einer Trennebene von 45° zur Achse des Einlaufstückes 1 verbindbaren Ablaufstück 2. Einlaufstück 1 und Ablaufstück 2 sind in ihrer um 45° zur Achse geneigten Trennebene 8 jeweils mit kreisringförmigen Flanschen 3 und 4 versehen und an diesen mittels Schraubklemmen 5 od.dgl. in beliebiger Drehstellung verbindbar, wobei zwischen den Flanschen 3 und 4 zweckmäßigerweise ein O-Ring 6 zur Dichtung vorgesehen ist. Das Einlaufstück 1 hat ein zentrisch mündendes Einlaufrohr 7 und hat, wie aus der Fig. 3 zu ersehen ist, in der Schnittebene III-III einen kreisförmigen Querschnitt, der nach rechts in Fig. 1 und 2 derart senkrecht zur Zeichenebene zu einem ovalen Querschnitt erweitert ist, daß der Schnitt in der Trennebene 8 wieder kreisrund ist. In der Ebene III-III an der eine Innenschulter 7' bildenden Mündung des Einlaufrohres 7 in den Gehäuseteil 9 des Einlaufstückes 1 befindet sich ein flach ringförmiger Klappenträger 10 mit einer um die Drehachse 11 schwenkbaren Klappe 12, die beim Schließen gegen die Innenschulter 7' als Klappensitz anliegt. Der Klappenträger 10 ist in seiner Position an der Innenschulter des Einlaufstücks 1 mittels eines Druckstückes 13 gehalten,

welches konzentrisch zum Gehäuseteil 9 ausgebildet ist und zwischen Einlauf- und Ablaufstück festgespannt ist, indem es in der Trennebene 8 bündig an der Stirnseite des Ablaufstückes 2 anliegt. Hierzu weist das Ablaufstück 2 in der Trennebene 8 den gleichen Innendurchmesser wie das Druckstück 8 auf und hat somit einen kleineren Innendurchmesser als das Einlaufteil 1. Das Ablaufrohr 14 ist am Ablaufteil 2 exzentrisch angesetzt, so daß,wie in der Fig. 2 zu sehen ist, in der 0°-Stellung kein Absatz entsteht.

Das Gehäuseteil 9 und entsprechend das Druckstück 13 sind gegenüber dem Durchmesser der Klappe 12, insbesondere in der zur Zeichenebene senkrechten Richtung erweitert, so daß die Klappe 12 ausreichend Platz für das Schwenken in die 90°-Stellung 12' hat. Die Klappe 12 kann am Klappenträger 10 aus flexiblem Kunststoffmaterial einstückig durch teilweises Ausstanzen ausgebildet sein, wie Fig. 3 zeigt.

Um das Kniestück für eine Stellung 90° nach aufwärts verwenden zu können, muß bei der in der Fig. 1 gezeigten Stellung nur der Klappenträger 10 um 180° gedreht eingebaut und das ganze Kniestück ebenfalls um 180° gedreht werden, so daß das Ablaufrohr 14 nach oben weist. Eine entsprechende Einbauart für die 0°-Stellung ist wegen des exzentrisch angeordneten Ablaufrohres 14 unzweckmäßig, da hierbei ein Stufenanstieg des Wassers entstehen würde.

Um die Formkosten für ein winkelverstellbares Kniestück zu verringern, können Einlaufstück und Ablaufstück

auch identisch ausgebildet sein. Eine derartige Ausführungsform ist in den Fig. 4 - 7 dargestellt. Der sowohl als Einlaufstück als auch als Ablaufstück zu verwendende Rohrabschnitt 15 hat ein mittig in den Gehäuseteil 16 mündendes Ein- bzw. Ablaufrohr 17. Der Gehäuseteil 16 hat einen ovalen Querschnitt und eine im Winkel von 45° zur Rohrachse verlaufende Stirnseite mit einem kreisringförmigen Flansch 18. In dem einlaufseitigen Rohrabschnitt 15 ist, wie bereits anhand der Fig. 1 - 3 beschrieben, ein Klappenträger 10 mit einer schwenkbaren Rückschlagklappe 12 aufgenommen und mittels eines Druckstückes 13, welches zwischen den beiden Rohrabschnitten 15, die an ihren Flanschen 18 dicht miteinander verbunden sind, gehalten. Hierzu ist das Druckstück 13 mit einem ringförmigen, nach außen vorspringenden Flansch 19 versehen, der zwischen den Flanschen 18 der Rohrabschnitte 15, beispielsweise in dafür vorgesehenen ringförmigen Aussparungen 20 aufgenommen ist. Zweckmäßigerweise trägt der Flansch 19 des Druckstücks 13 auch den Dichtring 6. Wie aus den Fig. 4 und 6 zu ersehen ist, ist bei dieser Ausführungsform in beiden Lagen des Einlaufteils eine 0°-Stellung möglich.

Bei der in den Fig. 8 - 11 dargestellten Ausführungsform eines winkelverstellbaren Kniestücks sind zwei Rückschlagklappen 12 und 22 vorgesehen und zwar eine Klappe 22 in der Trennebene 8 des Kniestücks und die andere Klappe 12 ihr vorgelagert im Einlaufstück 15 an der Einmündung des Einlaufrohres. Die Klappen sind jeweils um ihre Dreh-

achsen 11 und 21 schenkbar in ihren Klappenträgern 10 und 23 gelagert. Dabei können gemäß Fig. 8 die Drehachsen 11 und 21 auch auf verschiedenen Seiten liegen. Eine derartige Anordnung ist insbesondere als Rückflußverhinderer für Abwasserhebeanlagen geeignet, bei denen eine nach oben abgehende Leitung vorhanden ist. In den Fig. 9 und 11 sind hierzu die Rechts-Links-Ausführungen dargestellt. Damit die aus flexiblem Material bestehenden Klappen 12 und 22 dem Druck der in der Steigleitung stehenden Flüssigkeitssäule standhalten können, werden sie vorzugsweise mit einer Kunststoffplatte (nicht dargestellt) versteift. Die beiden Klappenträger 10 und 23 werden mittels zweier Druckstücke 13 und 24 in den beiden identisch ausgebildeten Rohrabschnitten 15 gehalten.
Das im eingangsseitigen Rohrabschnitt 15 aufgenommene Druckstück 13 weist zusätzlich zu dem nach außen ragenden Flansch 19 einen nach innen ragenden Flansch 25 auf, an dem der Klappenträger 23 anliegt und der den Klappensitz für die Klappe 22 bildet. Das zweite Druckstück 24 ist lediglich mit einem nach außen ragenden Flansch 19' versehen, der ebenfalls am Klappenträger 23 anliegt. Da die Rohrabschnitte 15 wiederum an ihren Flanschen 18 miteinander verbunden sind, sind die Druckstücke 13, 24 mit ihren Flanschen 19, 19' dazwischen eingespannt und dadurch wird der Klappenträger 23 zwischen den Druckstücken 13, 24 und der Klappenträger 10 zwischen dem Druckstück 13 und der Schulter des Einlaufstücks 15 fixiert.

Das in der Fig. 12a, b, c gezeigte Kniestück besteht aus zwei gekrümmten Rohren 26 und 27, die ebenfalls über Flansche 28 und 29 miteinander verbunden sind, wobei zwischen den Flanschen ein Klappenträger 30 mit einer in der Trennebene liegenden, um die Drehachse 31 schwenkbaren Klappe 32 befestigt ist. Die Klappe 32 ist von außen über einen Hebel 33 von Hand zu öffnen und zu schließen, wobei die Klappe 32 in der offenen Position in einer Tasche 34 im Eingangsstück 26 aufgenommen ist. Der Hebel wird in der Offenstellung durch eine Raste 36 arretiert.

Eine Abwandlung des in den Fig. 12a - 12c gezeigten Kniestücks ist in den Fig. 13a und 13b gezeigt. Hierbei ist die Klappe 32 als Rückschlagklappe ausgebildet und kann nach oben frei schwenken. Diese Rückschlagfunktion kann durch Nachuntendrücken des Hebels 33 unterbunden werden, wobei eine Schließzunge 35 dann die Klappe 32 in der geschlossenen Position hält. Der Hebel hat hierfür auch in der Schließstellung eine Raste. Im geöffneten Zustand befindet sich die Schließzunge 35 in einer hierfür vorgesehenen Tasche 34 des abflußseitigen Rohrabschnittes.

- Leerseite -

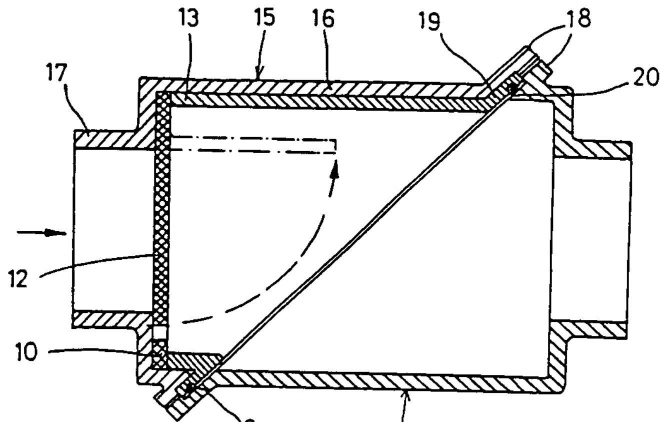

Fig.4

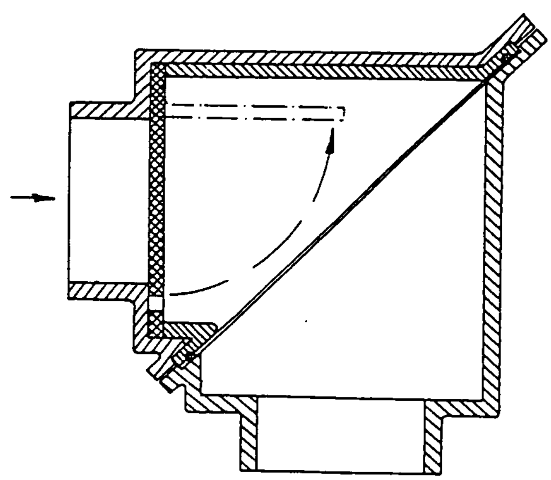

Fig.5

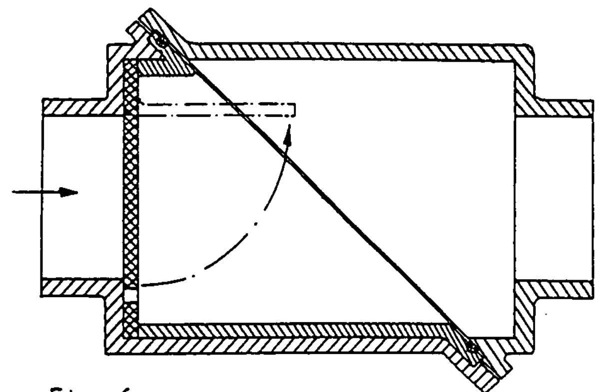
Fig. 6

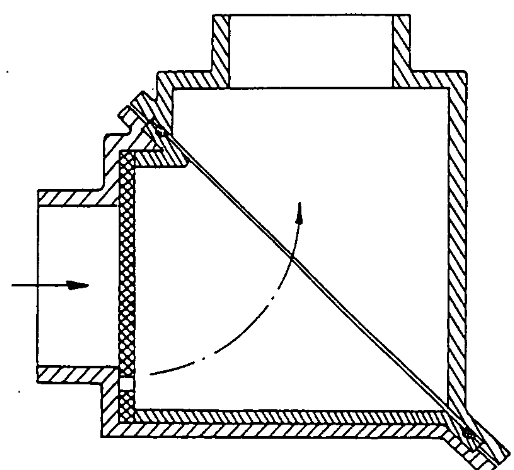
Fig. 7

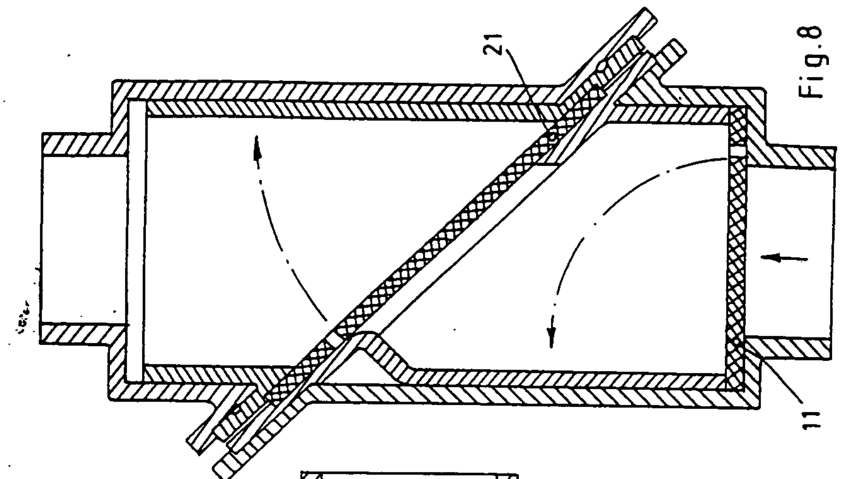

Fig.8

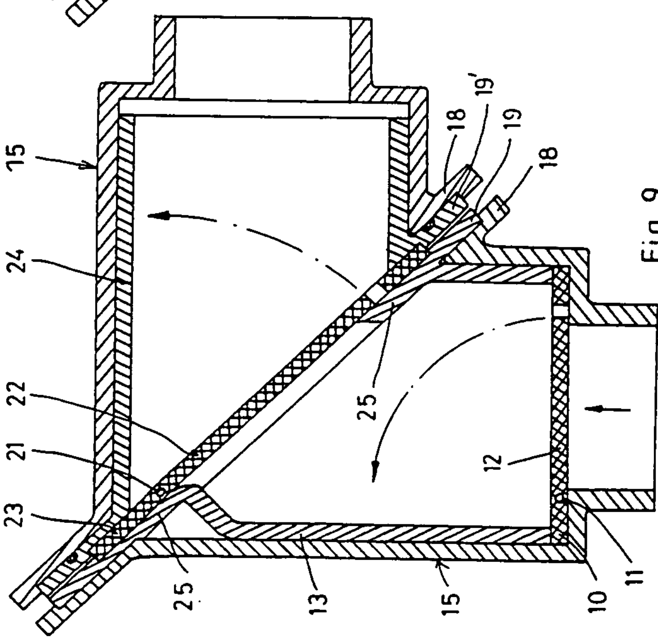

Fig.9

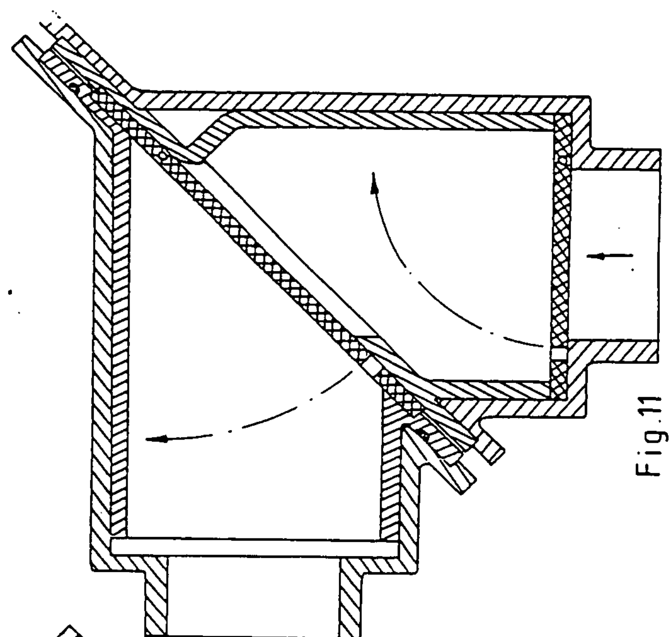

Fig.11

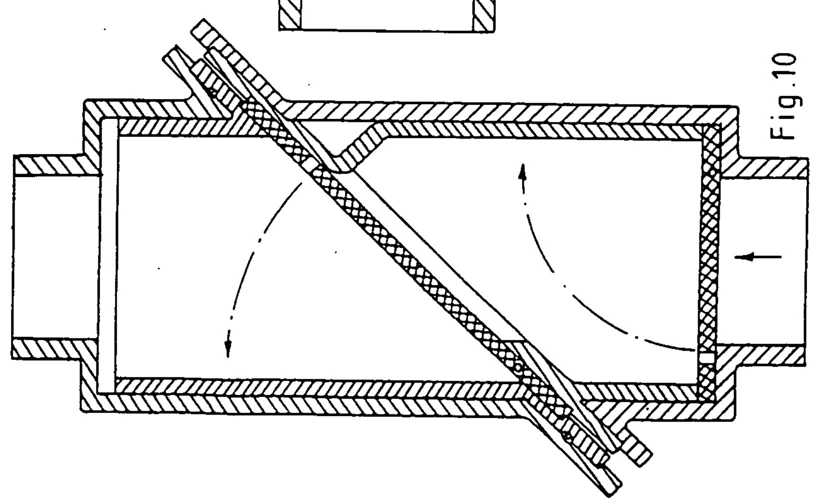

Fig.10

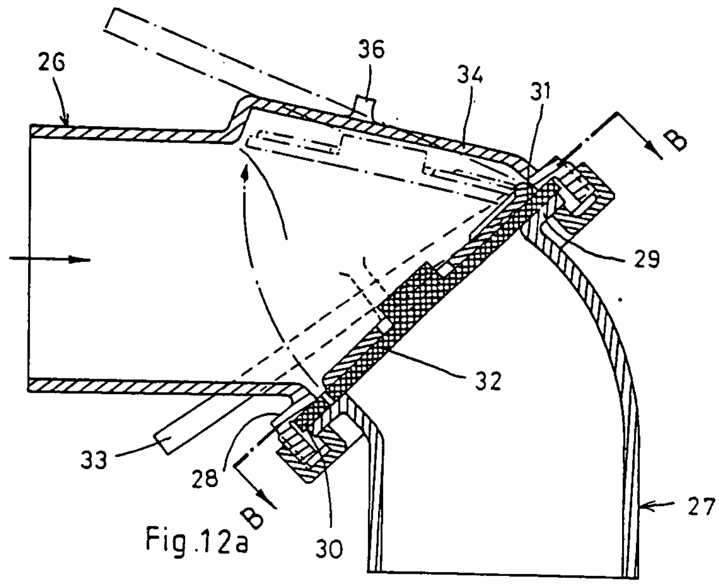

Fig.12a

Fig.12b

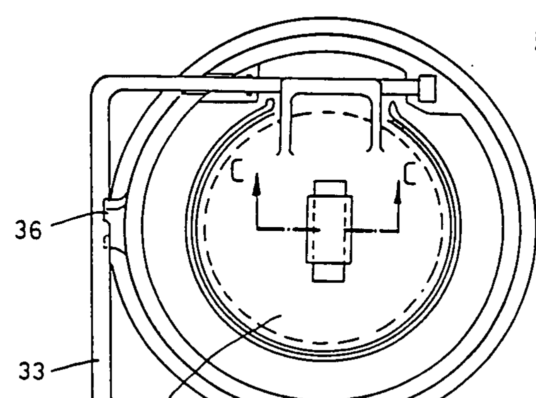

Fig.12c

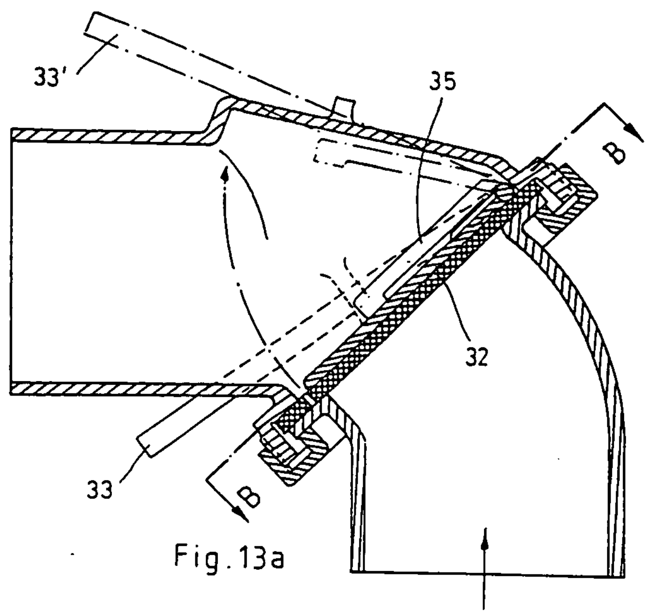

Fig. 13a

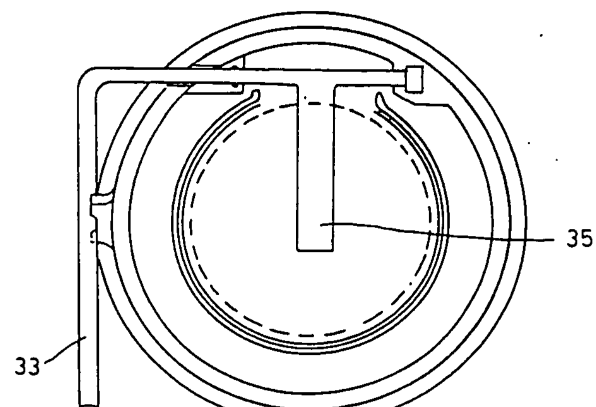

Fig. 13 b

Nummer: 34 14 077
Int. Cl.⁴: F 16 K 27/00
Anmeldetag: 13. April 1984
Offenlegungstag: 24. Oktober 1985

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PASSAVANT-WERKE · 6209 AARBERGEN 7

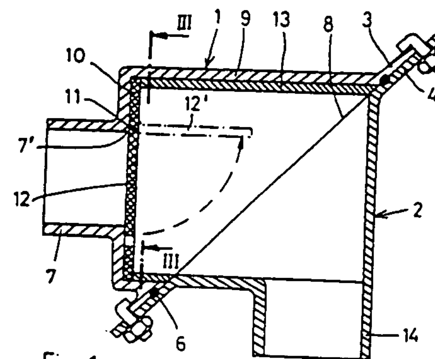


Fig.1

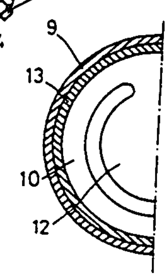


Fig.3

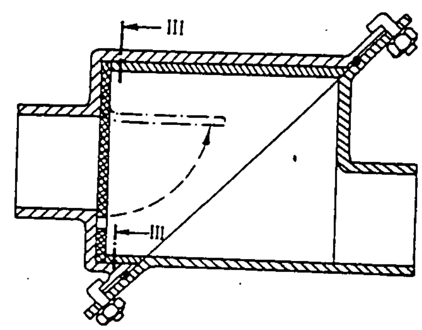
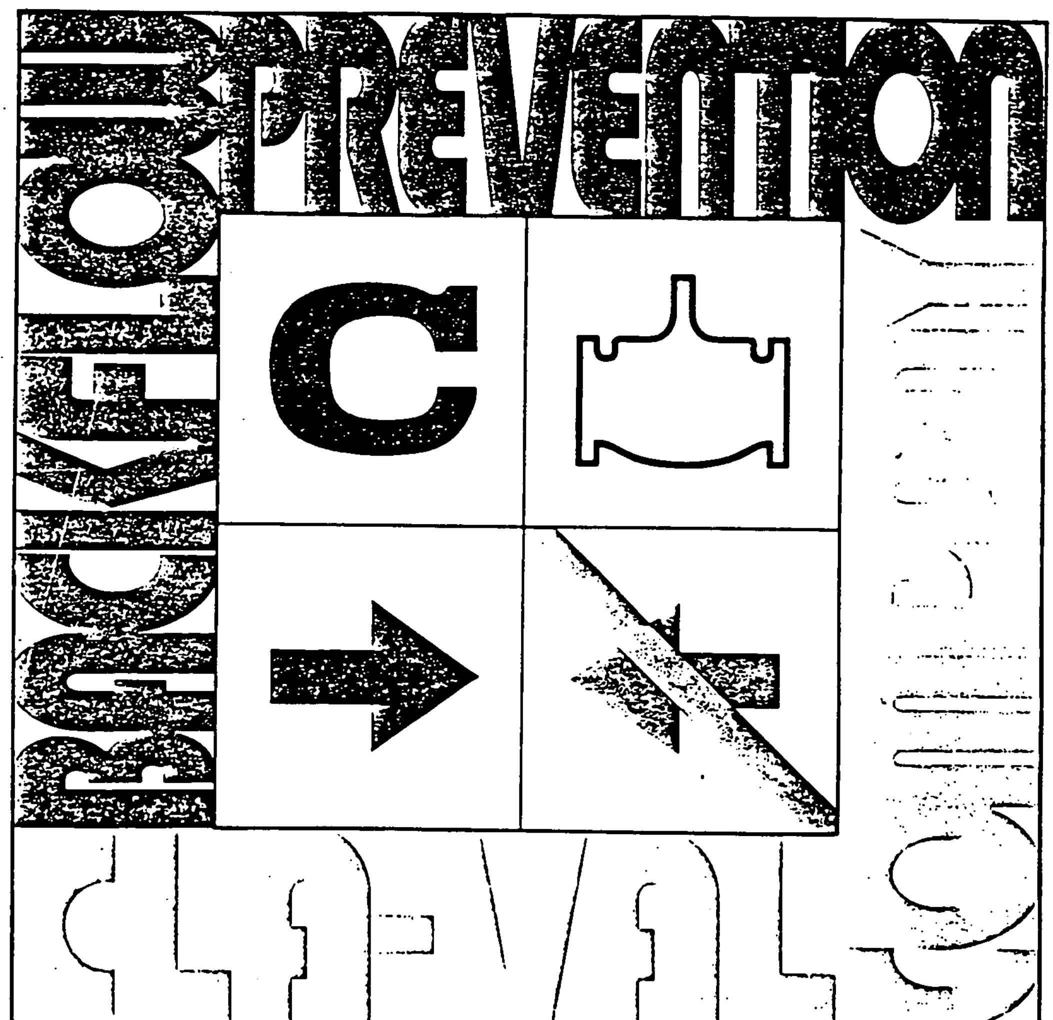


Fig.2

UXR

737/512



CLA-VAL CO.

BACKFLOW PREVENTER DIVISION

NEWPORT BEACH, CALIFORNIA, U.S.A.

Pure Water! A most important commodity today. Throughout the whole country, the whole world for that matter, great emphasis is being given to this precious natural resource.

Who would ever dream that water could become in short supply when generally it has always been available in abundance. Who could conceive that modern man would pollute and contaminate his own drinking water supply to the point of necessitating stringent government controls and regulations in order to guarantee that our waters would not be destroyed, totally and completely. It is difficult to imagine that rivers, streams, and lakes, large and small, could become so desecrated as to make them unfit for habitation by fish and plant life, to say nothing of the fact that these waters would be rendered totally unusable for human consumption.

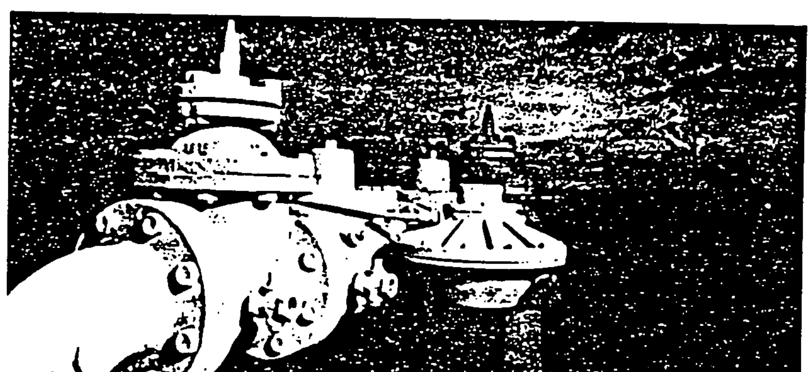
Laws and ordinances, rules and regulations, control agencies from federal, state and local levels, citizens groups, ecologists, ecological activists and many others today are bringing their combined forces to bear on halting this despoiling of our most sacred commodity, water!!

Since water is the "staff" of all life, the preservation of it must receive the full attention of every person. Our thoughts, energies and efforts must be brought to bear on solving the problem of water pollution and contamination.

One way to deal with this problem is to attack it at its source, where pollution and contamination occur. Prevent polluted and contaminated waters from entering potable water supplies! Stop degraded waters from returning to drinkable waters! A device that is designed to do just that is called a BACKFLOW Preventer. This device prevents waters that have become contaminated from ever coming in contact with pure water supplies.

The Backflow Preventer is not a new "gadget" recently devised to cope with a problem that seems to have developed in recent times. This instrument, commonly referred to as a cross-connection control device, has been available for many years, but has come into its own recently because of the accelerated water pollution problems of this generation.

The Backflow Preventer actually has been around for many decades, perhaps since the early 1900's. CLA-VAL COMPANY has produced Backflow Preventers since the 1940's. Leading the way in water pollution prevention, Cla-Val Co. has revised and refined its cross-connection control devices which have evolved into today's proven and approved Backflow Preventers.

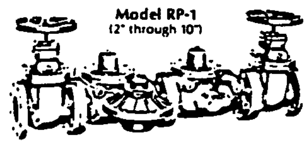
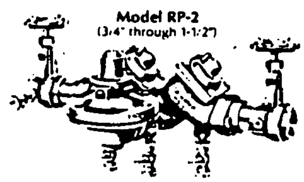
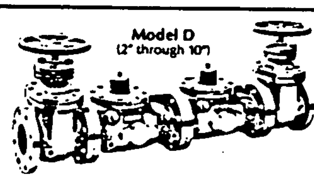
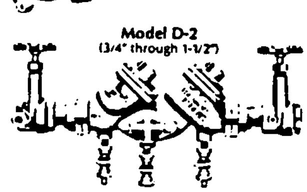
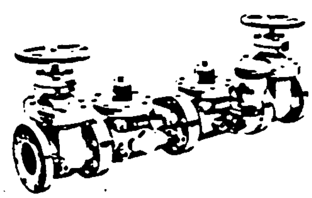
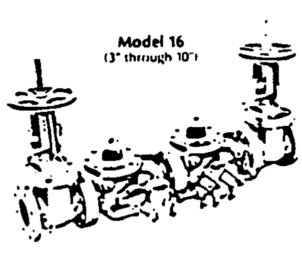


To better understand the problems which water pollution presents, let us consider what is meant by "cross-connection".

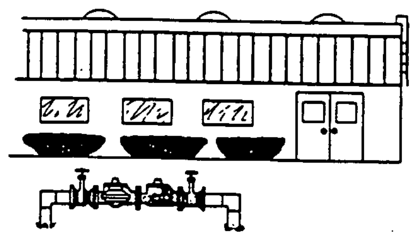
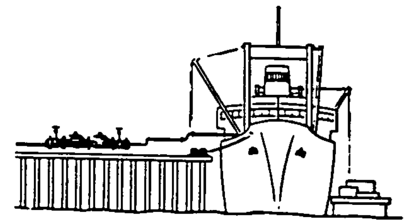
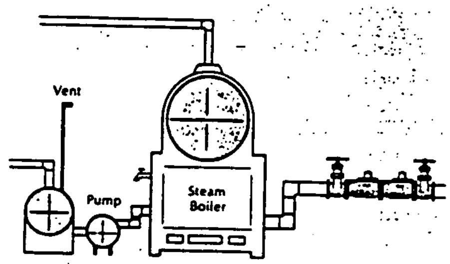
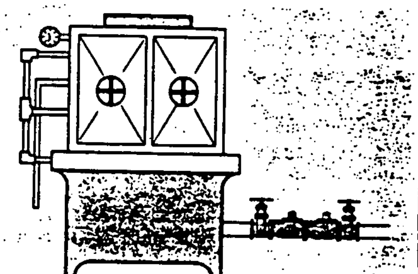
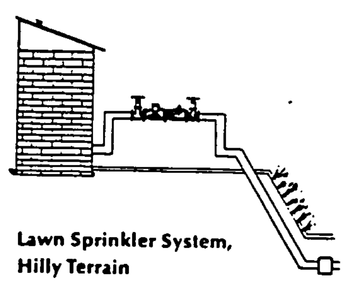
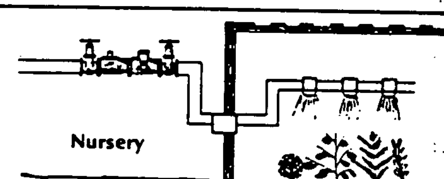
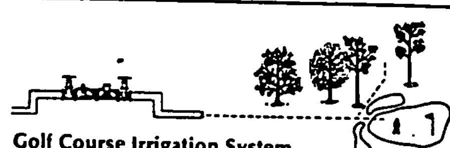
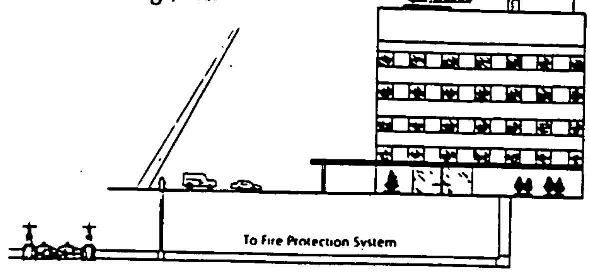
> *A cross-connection is generally defined as a piping connection that allows a pure, safe drinking water source to be physically connected to a contaminated or polluted system or source.*

The contaminated or polluted fluids flow through these connections from one system to another and their direction of flow will depend upon the pressure differential between the different systems. The contaminating substances can "backflow" into the piping of the drinking water systems in either of two ways. (1) By BACKPRESSURE, when the pressure in the non-potable system is greater than that in the drinking water system. (2) By BACKSIPHONAGE, when the pressure in the drinking water system becomes less than atmospheric due to a vacuum or partial vacuum in that system.

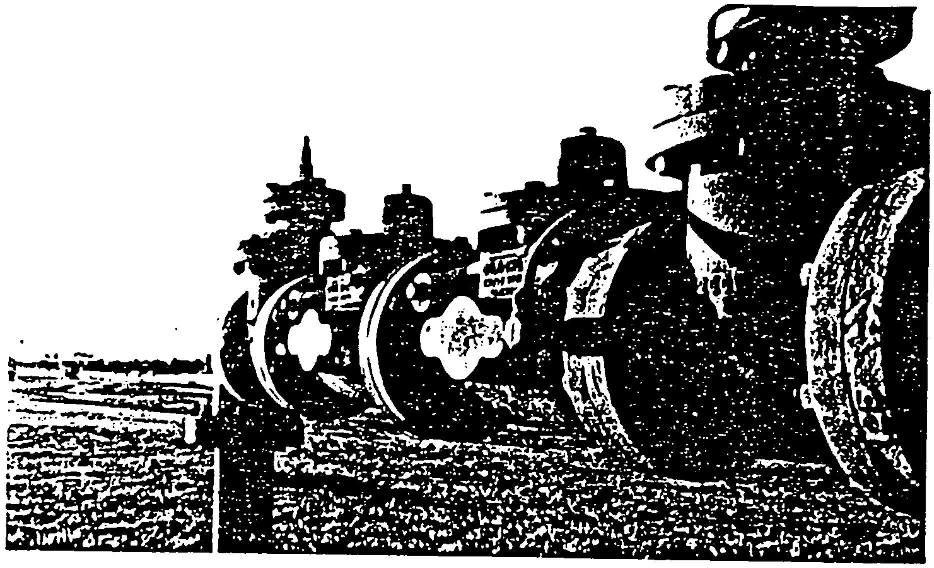
Because certain systems, processes or facilities cannot be operated without a direct cross-connection, it becomes necessary to provide a positive means to prevent backflow of contaminated waters into potable water supplies. This is accomplished by isolating the potentially hazardous system from the drinking water system through the proper installation of an approved backflow prevention device. The "Clayton" Backflow Preventers illustrated on these pages have been engineered and designed to meet todays demanding requirements for the control of cross-connections.

Clayton Identification	Device Description	Appli
Model RP-1 (2" through 10")  Model RP-2 (3/4" through 1-1/2") 	The Clayton Model RP-1/RP-2 Reduced Pressure Backflow Preventer is designed to positively prevent contamination of potable water supplies due to flow reversal caused by either back pressure or back-siphonage, and where high risk of contamination is present due to cross connections involving toxic substances. This is automatically accomplished by reducing the pressure through the device by means of the "reduced pressure principle". This unit combines maximum protection against backflow with exceptionally low head loss characteristics. • U.L Listed, sizes 2" through 10", without shut-off valves • For Fire Service, OS&Y shut-off valves required *(For detailed engineering data request Forms B-RP-1 and E-RP-2.)*	1. Water service to indust 2. Water service to hospit 3. Lawn sprinkler systems 4. In high-rise buildings' w 5. Steam boiler service w substances. 6. Water supply connecti mortuaries, morgues, c 7. Air conditioning chill w 8. Steam table, sterilizers, degreasing equipment. 9. Hydraulic elevators, se dye vats, laundry equip 10. Swimming pools. 11. Fire Protection Sprinkl additives.
Model D (2" through 10")  Model D-2 (3/4" through 1-1/2") 	The Clayton Model D/D-2 Double Check Valve Backflow Preventer provides a most reliable means of protection against intermediate degrees of contamination hazard, and should be installed where possible contaminants are found objectionable but not toxic. The double check design meets most requirements where possible cross-connections may occur, where low head loss is critical. • U.L Listed, sizes 2" through 10", without shut-off valves • For Fire Service, OS&Y shut-off valves required. *(For detailed engineering information, request Forms E-D and E-D-2.)*	1. Industrial plumbing sys 2. Swimming Pools. 3. Fire protection sprinkle additives. 4. Condenser equipment 5. Refrigeration equipme 6. Cold water supply to c 7. Manufacturing plants w in use. 8. Food processing equip 9. Laundry equipment. 10. Irrigation systems whe in use. 11. Multi-story buildings. 12. Vending machines.
Model 27 (2-1/2" through 6") 	The Model 27 Pressure-Type Vacuum Breaker is designed to prevent backflow of contaminated materials into potable water supply systems due to back-siphonage conditions. This unit can be installed where it is subject to continuous pressure but should not be placed in any installation where it would be subject to back pressures. *(For detailed engineering data, request Form E-27.)*	1. Lawn Sprinkler System 2. Turf Irrigation Installati 3. Water Supply Connect not subject to back pr
Model 16 (3" through 10") 	The Model 16 Double Check Detector is specifically designed for use on fire protection system pipeline installations. The device protects potable water supplies from possible contamination through cross-connection to fire service pipelines by preventing the return of "degraded fire system waters" into street supply mains which could happen when a fire department "pumper" connects to the system. This unit is also used to detect leakage or unauthorized use of water from fire system lines, which useage is immediately registered on the low flow meter on the unit. *(For detailed engineering information, request Form E – Model 16.)*	**Use on fire protection sy** 1. Prevent backflow 2. Detect unauthorized 3. Detect leakage in wet 4. Detect loss of water f

The uses, applications, and needs for cross-connection control devices are many and varied. For your ease and convenience we have listed above some of the numerous uses, together with typical application sketches, and the correct Clayton Backflow

cations	Typical Installation Illustrations
ial plants. ·ls and schools. ıter supply lines. h connections to toxic ns to medical buildings, emical & petroleum plants. ter systems & cooling towers. ıutoclaves, condensers & ·age pumps, etching tanks, nent and processing tanks. systems with chemical	 Industrial Buildings  Marine
ems. system without chemical ındustrial and medical. ısed boiler systems. ıere no toxic materials are ıent. no toxic chemicals are	 Closed Make-Up Tank with Pump and Vent  Pressure Steam Cooker
ıs. ·ns (direct or indirect) sure.	 Lawn Sprinkler System, Hilly Terrain  Nursery  Golf Course Irrigation System
ems to: ter used pe sprinklers n downstream hydrants	Hospitals, Public Buildings, Etc. 

Prevention Device, that best suits particular applications. This is only a partial list. Contact your local Cla-Val Company factory sales office for specific recommendations.



Clayton Backflow Preventer Features:

Positive operation • Cannot cause water hammer • Has no cavities to entrap foreign material • No internal or external weights • Has no sliding surfaces to gall or corrode • All internal parts are accessible from the top of the device without removing valve bodies from pipeline • All parts corrosion resistant • Low head loss at maximum flow rates • Meet requirements of major approval agencies • Test cocks on all models for testing convenience • Provides drip tight closure

Clayton Backflow Preventers Approved By:

Underwriters Laboratories Listed (UL)

University of Southern California
Foundation for Cross-Connection Control and Hydraulic Research

American Water Works Association, Standard No. C506

Ohio Environmental Protection Agency,
Division of Engineering, Office of Public Water Supply

Department Health, Education and Welfare,
Public Health Service, Food and Drug Administration, U.S.A.

International Association of Plumbing and Mechanical Officials

City of Los Angeles, California, Department of Building and Safety

County of Orange, California, Department of Health

County of Los Angeles, California, Department of Health Service

The Commonwealth of Massachusetts,
Department of Environmental Quality Engineering

State of Michigan, Department of Labor,
Plumbing Board, and Construction Code Commission

State of New York, Department of Health,
Bureau of Public Water Supply, Division of Sanitary Engineering

City of Cincinnati, Ohio, Water Works

State of Virginia, Department of Health

For Further Information Contact

BACKFLOW PREVENTER DIVISION
P.O. Box 1325
Newport Beach, California, U.S.A. 92663
Phone (714) 548-2201—Telex 678429—Cable: CLAVALCO

CLA-VAL CANADA LTD.
P.O. Box 10
Beamsville, Ontario, Canada LOR 1BO

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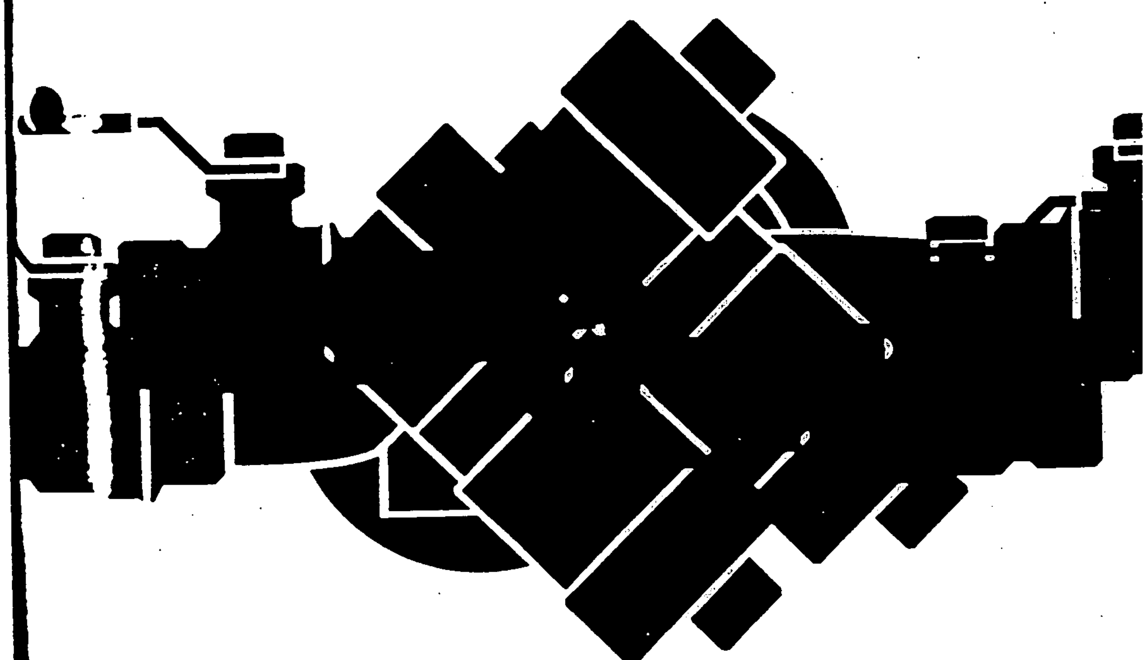
FEBCO®

BACKFLOW PREVENTION ASSEMBLIES



A division of CMB Industries

FEBCO® Specialists in the Protection c

Protecting Potable Water Supplies with Low Head Loss, Reliable Operation, and Easy Serviceability

The preservation of potable water supplies is necessary to the survival of every living thing. During the past 25 years Febco has designed and manufactured backflow prevention assemblies for just that purpose...backflow prevention assemblies which feature low head loss, reliable operation and easy serviceability.

Febco's success in backflow prevention is the result of many years of technological and manufacturing experience. From Febco's earliest days experienced engineers have combined theory with practice to design and manufacture the widest line of top quality USC and ASSE approved backflow prevention assemblies.

Febco's success is also the result of their interest in helping municipalities, engineers, architects, contractors, and the general public understand backflow prevention problems and the importance of utilizing backflow prevention assemblies to preserve our vanishing potable resources.

Febco...with superior designs, a modern manufacturing facility, and a goal to keep our drinking water pure and clean...the way nature meant it to be!

Backflow Prevention Assemblies: Why They Are Needed

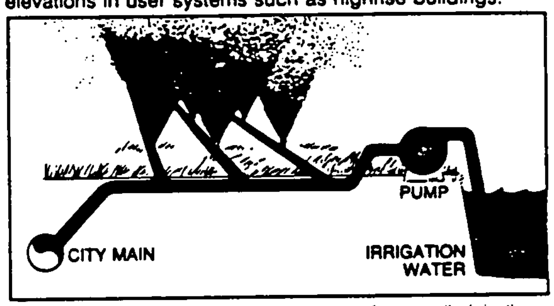
A cross connection control program protects the potable water supply from contaminents being introduced into the potable water system by backsiphonage or backpressure. Approved backflow prevention assemblies are necessary to protect the potable water from this contamination. Understanding backflow prevention assemblies and why they are used requires knowing what a cross connection is and why backflow can occur at a cross connection.

CROSS CONNECTION: Any point on a water system where a polluting substance may come in contact with potable water.

Examples: Any system piping that allows access to the potable water supply, any connected auxiliary water supply, submerged inlets, bypass arrangements, jumper connections, removable sections, swivel/changeover devices, temporary devices.

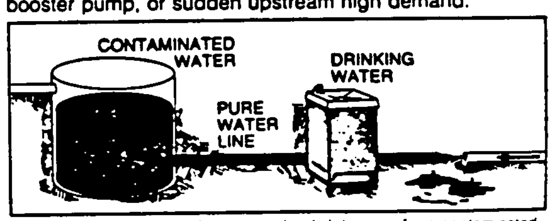
BACKFLOW: The undesirable reversal of the flow of water or mixtures of water and other undesirable substances from any source (such as used water, industrial fluids, gasses, or any substance other than the intended potable water) into the distribution pipes of the potable water system. There are two types of backflow conditions: backpressure and backsiphonage.

Backpressure: Occurs when the user system is at a higher pressure than the supply water system allowing undesirable substances to be "pushed" back into the potable water system. Causes can be booster pumps, potable water system connections for boilers, interconnections with other piping systems operating at higher pressures, or higher elevations in user systems such as highrise buildings.



In Utah, raw irrigation water was pumped through a farm standby irrigation connection into over half of the entire town's potable water system. The standby connection was not protected with a backflow prevention device.

Backsiphonage: Occurs when negative or reduced pressure exists in the supply piping allowing undesirable substances to be "drawn" into the potable water supply. Causes can be undersized supply piping, supply line breaks, reduced supply system pressure on the suction side of an on-line booster pump, or sudden upstream high demand.



Broken domestic supply line causes backsiphonage from contaminated water for domestic use.

LOW HAZARD CROSS CONNECTION: Any point on a water supply system where a polluting substance may come in contact with potable water aesthetically affecting the taste, odor or appearance of the water, but non-hazardous to health (non-toxic).

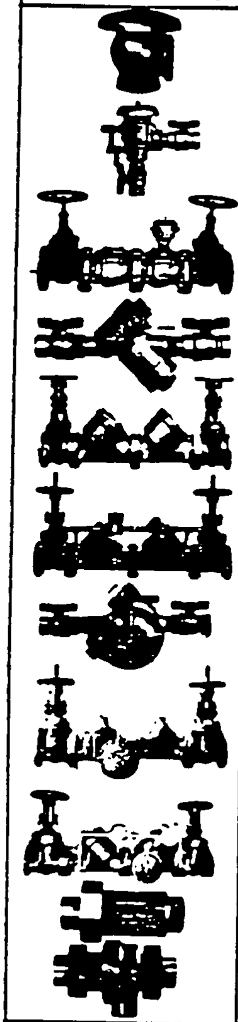
HIGH HAZARD CROSS CONNECTION: Any point on a water supply system where a polluting substance may come in contact with potable water creating a health hazard, causing sickness or death (toxic).

CONTINUOUS PRESSURE: In order to deliver water for immediate use most piping systems are continuously pressurized. Some backflow prevention assemblies cannot operate properly under continuous pressure. Check the chart to the right to determine where each assembly is applicable and under which conditions each can be used.

Types of Hazards and Backflow Prevention Assemblies

PRODUCT TYPE	POSSIBLE BACKSIPHONAGE	POSSIBLE BACK PRESSURE	CONTINUOUS PRESSURE	LOW HAZARD	HIGH HAZARD
Atmospheric Vacuum Breaker	710			710	710*
Pressure Vacuum Breaker	765 & 775		765** & 775	765 & 775	765** & 775
Double Check	805Y & 805YD**	805Y & 805YD**	805Y & 805YD**	805Y & 805YD**	
Double Check Detector Assembly	806YD DCDA	806YD DCDA	806YD DCDA	806YD DCDA	
Reduced Pressure and Reduced Pressure Detector Assembly	825Y & 825YD**	825Y & 825YD**	825Y & 825YD	825Y & 825YD**	825Y & 825YD
Dual Check and Double Check with Atmospheric Port	810 & 815 DCAP	810 & 815 DCAP	810 & 815 DCAP	810 & 815 DCAP	

* Consult local codes. ** Shown with optional shut-offs.



PRODUCT ILLUSTRATION	PAGE NO.	PRODUCT TYPE	SIZE	TYPE OF SERVICE	TYPE OF APPLICATION	APPROVALS, CLASSNS., & LISTINGS	MAXIMUM WORKING PRESSURE
	5	710 Atmospheric Vacuum Breaker	½", ¾", 1", 1¼", 1½", 2"	High Hazard Low Hazard	Commercial dishwasher and laundry machines, lawn sprinkler systems, chemical vats, X-ray tanks, laboratory sinks	ASSE, CSA IAPMO Listed SBCCI, USC	150 PSI
	5	Hose Bibb Vacuum Breaker	¾"				
	6	765* Pressure Vacuum Breaker	½", ¾", 1" 1¼", 1½", 2"	High Hazard Low Hazard Continuous Pressure	In-plant industrial applications for toxic or non-toxic protection, laboratories, swimming pools, laundries, lawn sprinkler systems, dentist offices	ASSE, CSA IAPMO Listed SBCCI, USC	150 PSI
	7	775 Pressure Vacuum Breaker	3", 4", 6", 8", 10"	High Hazard Low Hazard Continuous Pressure	In-plant industrial applications for toxic or non-toxic protection, laboratories, large irrigation systems, golf courses	IAPMO Listed	150 PSI
	8	805Y* Double Check	¾", 1", 1½", 2"	Low Hazard Possible Back Press. Continuous Pressure	Irrigation systems, sprinkler systems, industrial in-plant plumbing	ASSE, CSA IAPMO Listed SBCCI, USC	175 PSI
	9	805YD Double Check	2½", 3", 4" 6", 8", 10"	Low Hazard Possible Back Press. Continuous Pressure	Sprinkler irrigation systems, fire sprinkler systems without chemical additives, protection of industrial plants, in-plant plumbing systems	ASSE, CSA IAPMO Listed SBCCI, USC UL, FM③,②	175 PSI
	10	806YD DCDA Double Check Detector Assembly	¾" Bypass 3", 4", 6", 8", 10"	Low Hazard Possible Back Press. Continuous Pressure	Fire sprinkler pipelines, low hazard service with metering of unauthorized water usage	ASSE, CSA USC, UL⑥ FM⑥,②	175 PSI
	11	825Y* Reduced Pressure Assembly	¾", 1", 1¼" 1½", 2"	High Hazard Possible Back Press. Continuous Pressure	Industrial plants, hospitals, irrigation, morgues, boiler feeds, mortuaries, water lines needing maximum protection, chemical plants	ASSE, CSA IAPMO Listed SBCCI, USC	175 PSI
	13	825YD Reduced Pressure Assembly	2½", 3", 4", 6", 8", 10"	High Hazard Possible Back Press. Continuous Pressure	Industrial plants, hospitals, irrigation systems, morgues, mortuaries, boiler feeds, chemical plants, fire sprinkler systems with chemical additives	ASSE, USC, IAPMO Listed SBCCI, USC UL, FM③,②	175 PSI
	15	826YD Reduced Pressure Detector Assembly	2½", 3", 4"	High Hazard Possible Back Press. Continuous Pressure	Fire sprinkler pipelines, high hazard service with metering of unauthorized usage	USC, UL, FM	175 PSI
		825YD RPDA Reduced Pressure Detector Assembly	6", 8", 10"			Contact Factory	
	16	810 Dual Check	¾", 1" IPS ⅝", ¾", & 1" meter conn.	Low Hazard Continuous Pressure	Residential water service	ASSE(¾"), SBCCI CSA(¾")	175 PSI
	16	815 Dual Check with Atmospheric Port	½", ¾"	Low Hazard Continuous Pressure	Boiler feed lines, non-toxic laboratory equipment installations, sterilizers	ASSE Listed 1012 CSA	175 PSI

MISCELLANEOUS PRODUCTS

	17	3130 "Y" Strainer	½"-2"	NA	Installed before backflow preventers, control valves, meters, and other equipment to protect them from damage due to debris, dirt, scale and other foreign material		WSP 250/ WOG 400 PSI
		3131 "Y" Strainer	½"-2"	NA			WSP 300/ WOG 400 PSI
		3132 "Y" Strainer	2½"-12"	NA			WSP 125/ WOG 175 PSI
		3102 "Y" Strainer	2½"-12"	NA			WSP 250/ WOG 400 PSI
	17	AGD-Y AGD-L	¾"-2" 2½"-10"	NA NA	Air Gap Drain for use with Reduced Pressure Assemblies		NA NA

NOTES. ① Consult the factory for special high temperature devices. ② UL/FM approved installations must include OS & Y gate valves.
③ 2½" not applicable. ④ For temperatures in excess of 140°F specify-HW on model number.
⑤ Epoxy coated internal. ⑥ 3" not applicable.
* Shown with optional ball valve shut-offs.

HYDROSTATIC TEST PRESSURE	TEMP. RANGE	END DETAIL	MAIN VALVE BODY	MAIN VALVE TRIM	RELIEF VALVE BODY & TRIM	ELASTOMERS	SPRINGS/MISC.
150 PSI	32°F to 110°F	½" through 2" Threaded ANSI B2.1 ¾" ANSI B2.4	Bronze ASTM B584-78	NA	NA	NA	NA
300 PSI	32°F to 180°F	½" through 2" Threaded ANSI B2.1	Bronze ASTM B584-78	NA	NA	Seat Discs Nitrile ASTM D-2000	Stainless Steel 300 Series Spring Available with Ball Valves
300 PSI	32°F to 140°F	3" - 4" Flanged ANSI B16.24 6" - 10" Flanged ANSI B16.1	3" - 4" Bronze ASTM B584-78 6" - 10" Ductile Iron ASTM A-536	NA Bronze ASTM B61	NA	Seat Discs Nitrile ASTM D-2000	Vacuum Breaker Head: Bronze ASTM B584-78
350 PSI	32°F to 140°F (Emerg. 180°)	¾" through 2" Threaded ANSI B2.1	Bronze ASTM B584-78	NA	NA	Seat Discs Nitrile ASTM D-2000	Stainless Steel 300 Series Spring Available with Ball Valves
350 PSI	32°F to 140°F	Flanged ANSI B16.1	Ductile Iron ASTM A-536 (Epoxy coated internal: 10-20 mil)	Bronze ASTM B-61	NA	Seat Discs Nitrile ASTM D-2000	Stainless Steel 300 Series Spring Available with OS & Y Gates
350 PSI	32°F to 140°F	Flanged ANSI B16.1	Ductile Iron ASTM A-536 (Epoxy coated internal)	Bronze ASTM B-61	NA	Seat Discs Nitrile ASTM D-2000	Bypass meter: totalizing Size ⅝" x ¾", Std Brz ASTM B584-78 Shut-off valves: OS & Y UL Listed
350 PSI	32°F to 140°F ④ (Emerg. 180°)	¾" through 2" Threaded ANSI B2.1	Bronze ASTM B584-78	NA	Bronze ASTM B584 -78	Seat Discs Nitrile ASTM D-2000 Diaphragms: Nitrile fabric reinforced	Stainless Steel 300 Series Spring Available with Ball Valves
350 PSI	32°F to 140°F	2½" through 10" Flanged ANSI B16.1	Ductile Iron ASTM A-536 (Epoxy coated internal: 10-20 mil)	Bronze ASTM B-61	Bronze ASTM B-61	Seat Discs: Nitrile ASTM D-2000 Diaphragms: Nitrile-fabric reinforced	Stainless Steel 300 Series Spring Available with OS & Y Gates
350 PSI	32°F to 140°F	Flanged ANSI B16.1	Ductile Iron ASTM A-536 (Epoxy coated internal: 10-20 mil)	Bronze ASTM B-61	Bronze ASTM A-536	Seat Discs: Nitrile ASTM D-2000 Diaphragms: Nitrile-fabric reinforced	Bypass meter: totalizing Size ⅝" x ¾", Std. Brz ASTM B584-78 Shut-off valves: OS & Y UL Listed
350 PSI	32°F to 180°F	¾" & 1" Threaded ANSI B2.1	Bronze ASTM B584-78	NA	NA	Nitrile ASTM D-2000	Stainless Steel 300 Series Spring
350 PSI	40°F to 210°F (Emerg. 250°)	½" & ¾" Union Connection	Bronze ASTM B584-78	NA	NA	Ethlene Propylene	Stainless Steel Spring

NA NA NA NA	NA NA NA NA	Screwed Screwed Flanged Flanged	Class B Cast Iron ASTM A-126 Brz ASTM B-62 Class B Cast Iron ASTM A-126 Class B Cast Iron ASTM B-126	NA NA NA NA	NA NA NA NA	Silicone Silicone Non Asbestos Non Asbestos	Sizes: ½" - 2" Standard screen: 20-mesh S.S. Optional screens avail. Sizes: 2½" - 10" Std. screen: ⅟₁₆ perf. 6"-12": ⅛" perf Stainless Steel
NA NA	NA NA	1" NPT 2" NPT	Bronze Bronze	S.S. Fasteners	NA NA	NA NA	NA NA

Model 710 Atmospheric Vacuum Breaker (½" Thru 2")

Febco's Model 710 atmospheric vacuum breaker provides positive protection against backsiphonage of impure water into the main supply in the event that pressure loss causes vacuum conditions. A floating poppet seals the air inlet when the unit is pressurized. When a backsiphonage condition occurs, the poppet drops to allow air to enter the downstream piping. At the same time the poppet shields the water inlet to prevent foreign materials from entering the upstream piping. Restoration of pressure (flow) lifts the poppet to seal the air inlet. Poppets in the Model 710 are molded plastic and are for use on cold water service.

Model 710 SELECTION CRITERIA:

- Medium hazard service.
- No continuous pressure operation.
- No possible backpressure. (Consult local codes.)

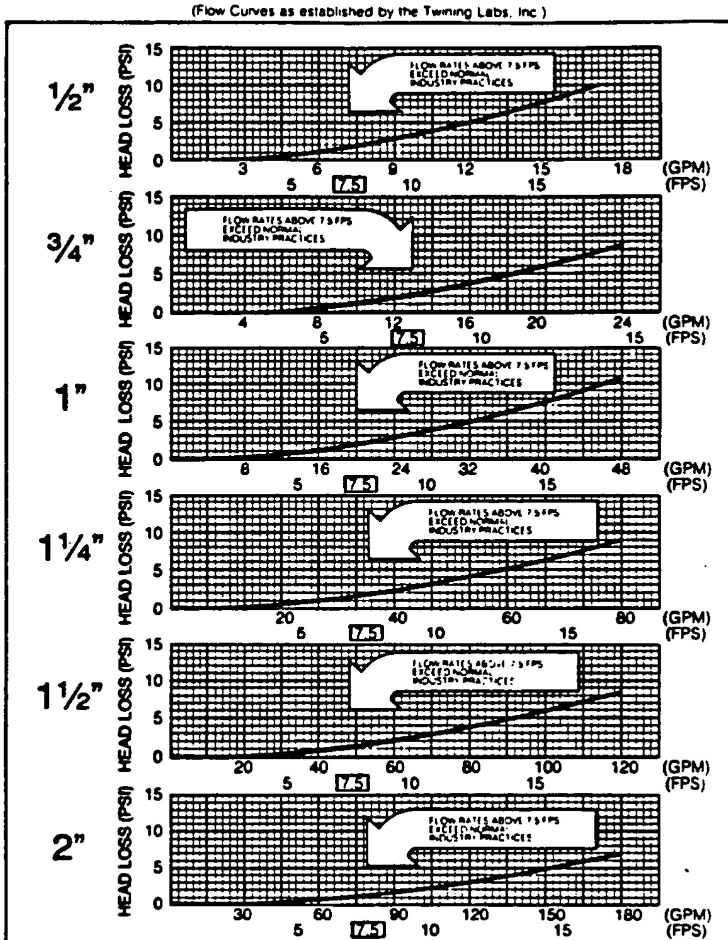
Hose Bibb Vacuum Breaker

The Hose Bibb Vacuum Breaker protects against backsiphonage through hose connections. While pressurized a disc seals the air inlet ports. At low pressure or under backsiphonage conditions a spring forces an opening. The unit is drainable for freeze protection without removal.

See page 3 for applicable approvals.

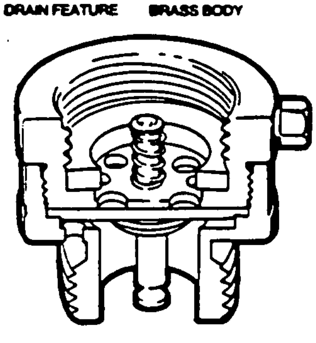
Model 710 Flow Curves

(Flow Curves as established by the Twining Labs, Inc.)

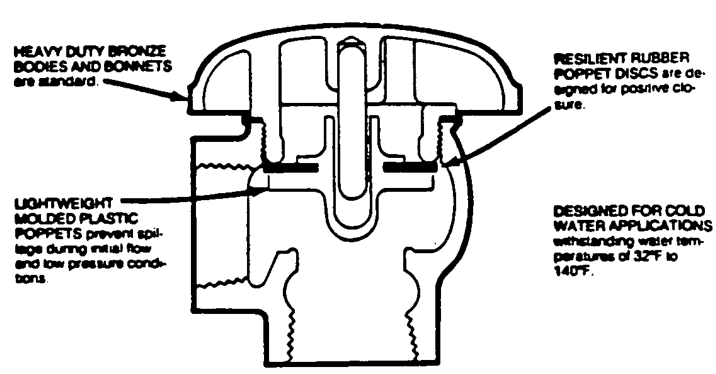


NOTES:
1. Velocities are calculated for flows in Schedule 40 steel pipe.
2. Typical water system flow velocities of 0 to 7.5 FPS should be used for head loss efficiency comparisons.

Features



Features of the Model 710



Model 765 Pressure Vacuum Breaker Assembly (½" Thru 2")

The Model 765 pressure vacuum breaker assembly is used to isolate entire industrial (non-potable) or irrigation lines from the potable water systems. It has the ability to withstand supply pressure for long periods and to prevent backflow of toxic and non-toxic water into the potable water system in backsiphonage conditions.

The Model 765 consists of a bronze body with a double guided spring loaded check valve which closes tightly when the pressure of the device drops below 1 PSI or when zero flow occurs. The 765 also includes an air inlet port that opens to break a siphon when the pressure in the device drops to 1 PSI. There are two threaded gate valves and two test cocks. This device is not to be installed where backpressure may occur.

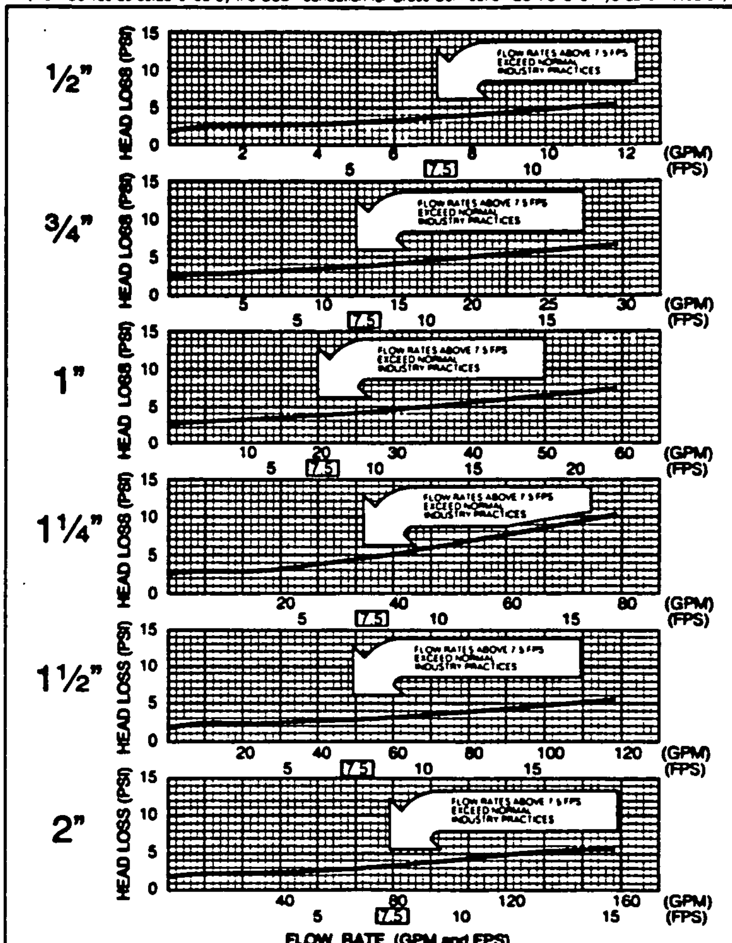
- Reversible seat disc.

Model 765 SELECTION CRITERIA:
- High hazard service.
- Continuous pressure operation.
- No possible backpressure.

See page 3 for applicable approvals.

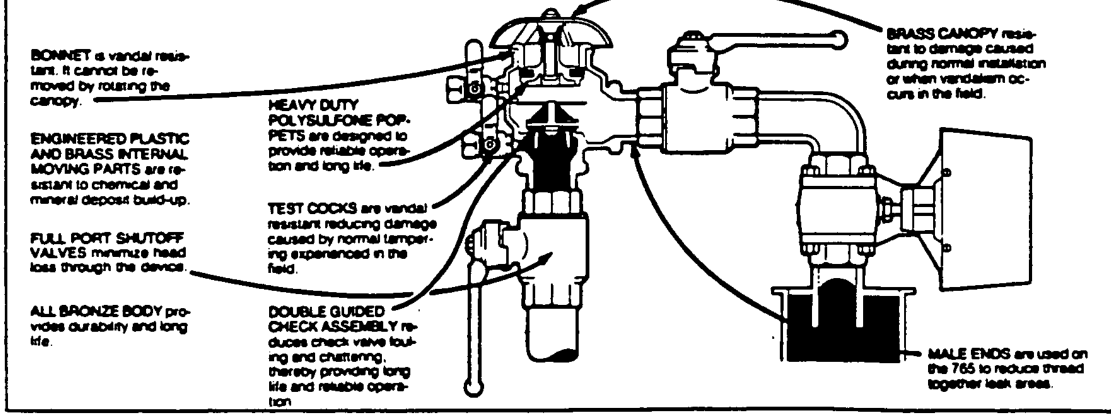
Model 765 Flow Curves

(Flow Curves as established by the USC Foundation for Cross Connection Control and Hydraulic Research)



NOTES:
1. Velocities are calculated for flows in Schedule 40 steel pipe.
2. Typical water system flow velocities of 5 to 7.5 FPS should be used for head loss efficiency comparisons.

Features of the Model 765 (½" thru 2")



⁄Iodel 775 ⁾ressure Vacuum ⅃reaker Assembly 3" Thru 10")

he Model 775 pressure vacuum reaker assembly consists of two ıdependently operating spring loaded heck valves with a vacuum breaker air ılet head mounted on the second heck and three testcocks. An inlet ate valve and outlet gate valve omprise a complete serviceable ssembly.

he 3" and 4" assemblies consist of two ıline bronze bodies, covers and a acuum breaker head assembly. :orrosion resistant internal parts are ;andard. The 6" through 10" ssemblies consist of two independent ⁄" pattern, ductile, spring loaded heck valves and one bronze body acuum breaker head. Internal epoxy oating is standard and all internal arts are corrosion and wear resistant. ıate valves supplied are flanged on-rising stem. The assemblies are ıted to 150 PSI working pressure and ıll withstand water temperatures of 2°F to 140°F.

oth check valves and the vacuum reaker head are constructed so they an be serviced without removing the ssembly from the line.

ı the event of a backsiphonage ondition, the two check valves close ıd the vacuum breaker head air inlet pens, allowing air to be drawn into the ownstream piping, thus stopping acksiphonage of contaminated water.

Reversible seat disc.

Serviceable from the top of the assembly.

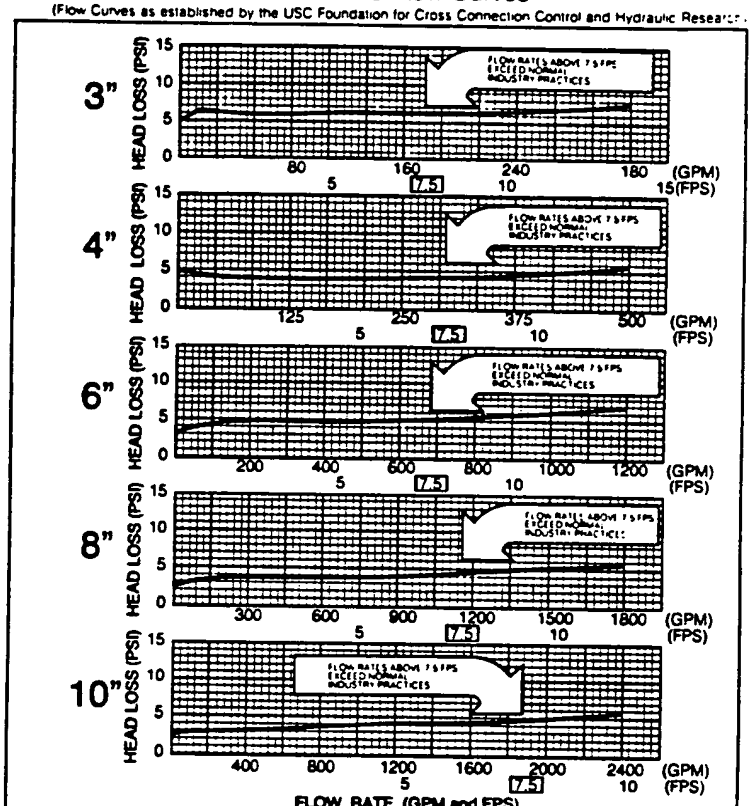
lodel 775 SELECTION CRITERIA:
- High hazard service.
- Continuous pressure operation.
- No possible backpressure.

ee page 3 for applicable approvals.

ontact Factory for sizes available.

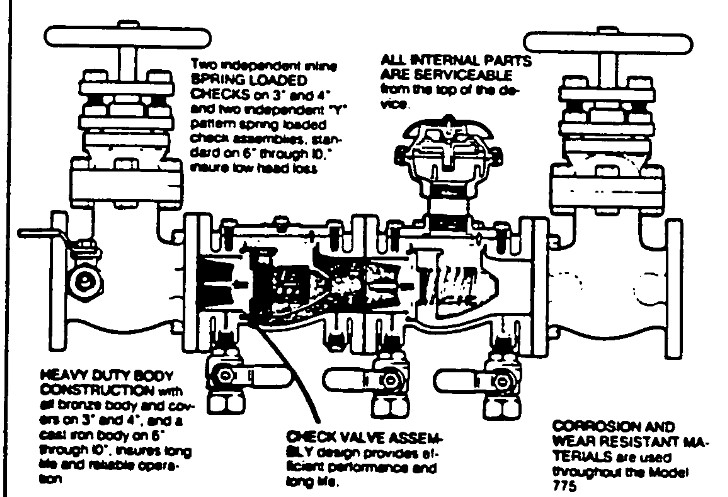
Model 775 Flow Curves

(Flow Curves as established by the USC Foundation for Cross Connection Control and Hydraulic Resear...



NOTES:
1. Velocities are calculated for flows in Schedule 40 steel pipe.
2. Typical water system flow velocities of 5 to 7.5 FPS should be used for head loss efficiency comparisons.

Features of the Model 775 (3" thru 10")



* AVAILABLE WITH RESILIENT SEATED SHUT-OFFS.

Model 805Y Double Check Backflow Prevention Assembly (¾" thru 2")

The Model 805Y double check backflow prevention assembly consists of two independently operating check valves with an inlet and outlet shut-off valve and four test cocks. Each check valve is a "Y" pattern, spring loaded, center guided, poppet type. In normal operation the check valves open with flow demand. During no-flow conditions, each check valve will hold 1 PSI in the flow direction.

The Model 805Y consists of a bronze body with bronze caps. All internal parts are of corrosion resistant materials.

All Model 805Y assemblies are constructed so that all internal parts can be serviced without removing the device from the line. These assemblies are rated to 175 PSI water working pressure and water temperatures from 32°F to 140°F.

Standard features of the Febco Model 805Y include the "Y" body designed to insure (1) low head loss, (2) reliable operation, and (3) easy serviceability.

- Reversible seat disc.
- Low head loss.

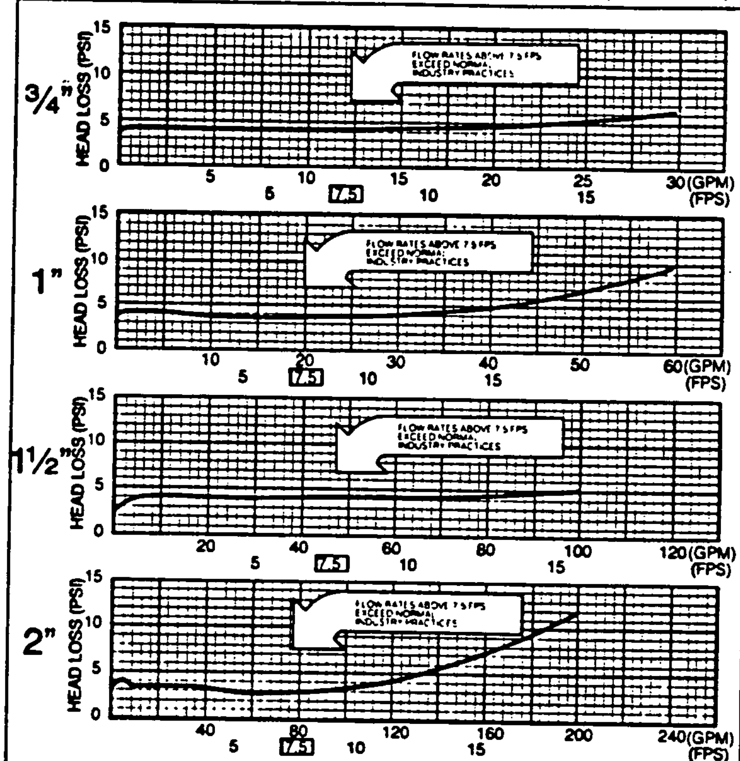
Model 805Y SELECTION CRITERIA:

- Low hazard service.
- Continuous pressure operation.
- Possible backpressure.

See page 3 for applicable approvals.

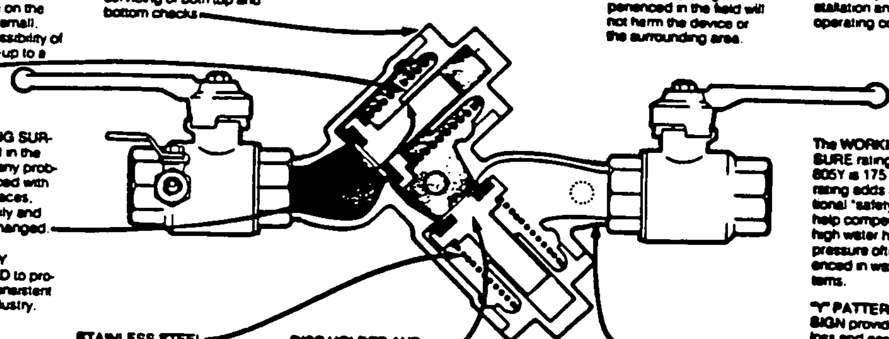
Model 805Y Flow Curves

(Flow Curves as established by the USC Foundation for Cross Connection Control and Hydraulic Research)



NOTES:
1. Velocities are calculated for flows in Schedule 40 steel pipe.
2. Typical water system flow velocities of 5 to 7.5 FPS should be used for head loss efficiency comparisons.

Features of the Model 805Y (¾" thru 2")



NOW WITH STAINLESS STEEL DuraCheck®

Model 805YD Double Check Backflow Prevention Assy. (2½" thru 10")

The Model 805YD double check backflow prevention assembly (2½" through 10") consists of internally epoxy coated ductile bodies and covers. The bodies are a "Y" pattern design incorporating two spring loaded, stainless steel, center guided check assemblies with bronze seat rings and stainless steel springs. Flanged inlet and outlet full port shut-off valves and four test cocks are included. All internal parts are of corrosion resistant materials.

In normal operation the check valves open with flow demand. During no-flow conditions, each check valve will hold 1 PSI in the flow direction. End connections are flanged.

All Model 805YD assemblies are constructed so that all internal parts can be serviced without removing the assembly from the line. These assemblies are rated to 175 PSI water working pressure and water temperatures from 32°F to 140°F.

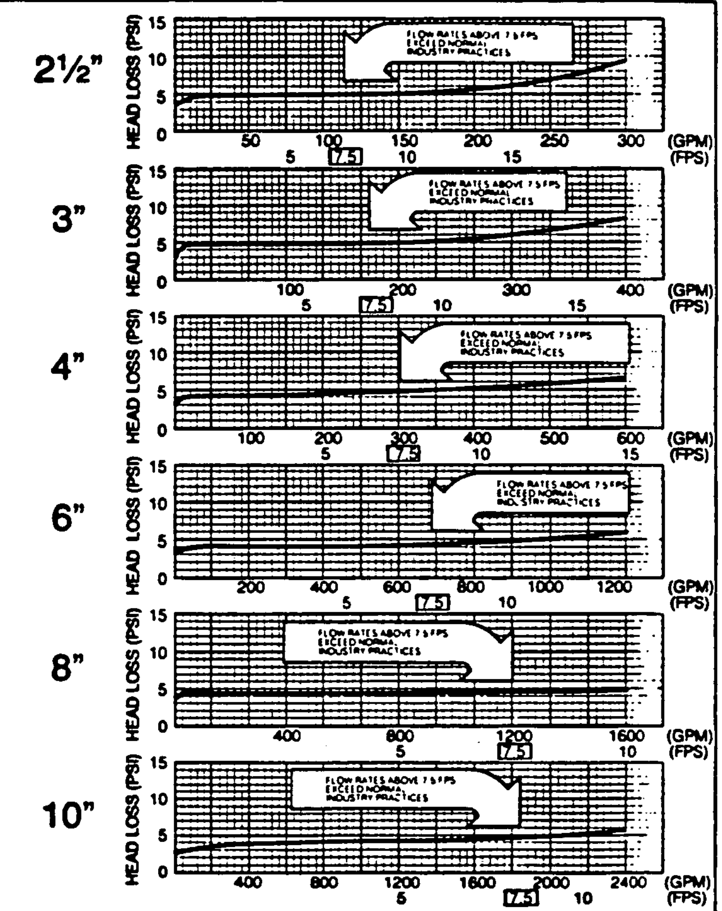
- Ductile iron bodies.
- DuraCheck stainless steel check assembly.
- OS & Y gate valves on all UL/FM assemblies.
- Reversible seat discs.
- Resilient seated shut-offs available upon request.

See page 3 for applicable approvals.

Model 805YD SELECTION CRITERIA:
- Low hazard service.
- Continuous pressure operation.
- Possible backpressure.

Model 805YD Flow Curves

(Flow Curves as established by the USC Foundation for Cross Connection Control and Hydraulic Research)



NOTES:
1. Velocities are calculated for flows in Schedule 40 steel pipe.
2. Typical water system flow velocities of 5 to 7.5 FPS should be used for head loss efficiency comparisons.

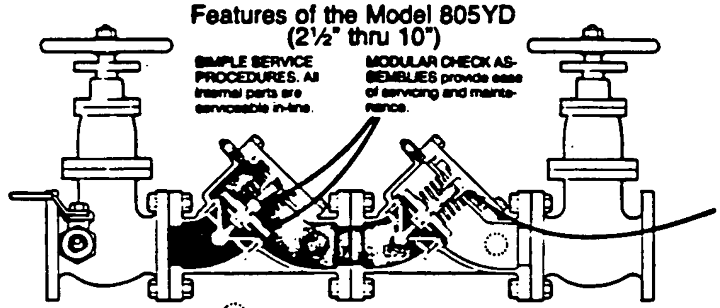
Features of the Model 805YD (2½" thru 10")

LIGHTWEIGHT, DURABLE DURACAST DUCTILE IRON BODY DESIGN with internal epoxy coating. Resistant to damage caused by normal installation and operating conditions.

The DURACHECK ALL STAINLESS STEEL CHECK ASSEMBLY resists corrosion, prolongs valve life, and promotes reliable operation.

SIMPLE SERVICE PROCEDURES. All internal parts are serviceable in-line.

MODULAR CHECK ASSEMBLIES provide ease of servicing and maintenance.



The WORKING PRESSURE RATING on the 805YD is 175 PSI. This rating adds an additional "safety factor" to help compensate for high water hammer pressures often experienced in water systems.

CENTER GUIDED CHECKS resist chemical build-up and provide reliable operation in harsh water environments. Delrin bushing is replaceable and facilitates check operation.

* AVAILABLE WITH RESILIENT SEATED SHUT-OFFS.

◌ DENOTES TEST COCK LOCATION

Model 806YD DCDA Double Check Detector Assembly (3" thru 10")

NOW WITH STAINLESS STEEL DuraCheck®

The Model 806YD DCDA Assembly prevents contamination of potable water by backflow from the fire protection system and detects leaks and unauthorized water uses.

The Model 806YD main line unit consists of two independent, "Y" type spring loaded ductile check valves, two shut-off valves and four test cocks. The spring loaded, stainless steel center guided checks with soft elastomer discs provide drip tight closure against backflow. The "Y" pattern valve design provides low pressure loss at the high flow rates. The shut-off valves are OS & Y type, UL listed for fireline service.

The bypass line assembly consists of a water meter in series with a double check valve. The meter is a total type with accurate registration between 1 and 20 GPM flow rates. The double check consists of two independently acting, spring loaded, center guided check valves. The static pressure drop across both checks is approximately 2 PSI less than the mainline check valves.

All flow up to approximately 5 GPM is through the bypass line. Above this flow rate the main line check valves begin to open and flow occurs through the main line and the bypass line. This operation at low flow rates is accomplished by designing the differential pressure drop across the bypass double check valve to be slightly less than the main line double check valve. Therefore the mainline check valve remains closed so that any flow through the fire line system is registered by the bypass meter.

- DuraCheck stainless steel check assembly.
- OS & Y gate valves are standard.
- Ductile iron bodies.
- Reversible seat discs.

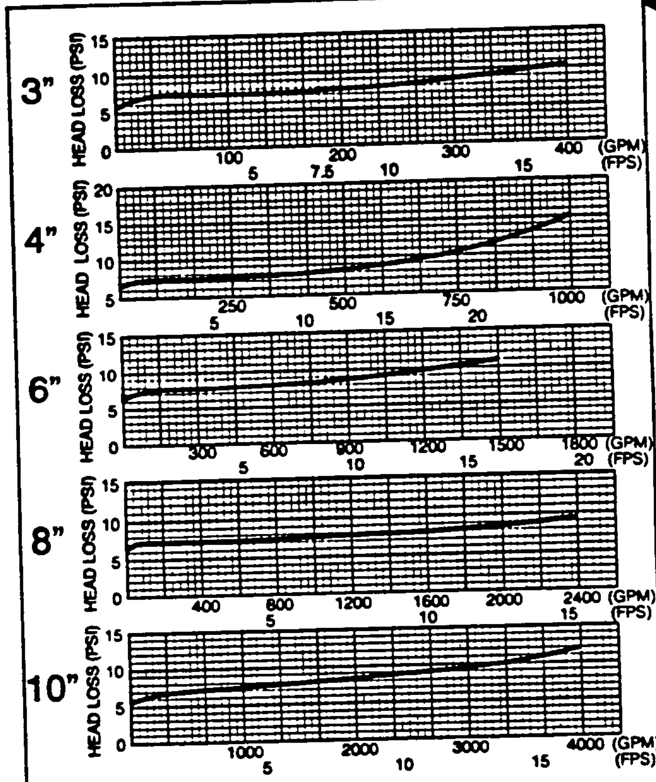
Model 806 YD DCDA SELECTION CRITERIA:

- Low hazard service.
- Continuous pressure operation.
- Possible backpressure.

See page 3 for applicable approvals.

Model 806YD DCDA Flow Curves

(Flow Curves as established by the USC Foundation for Cross Connection Control and Hydraulic Research)



FLOW RATE (GPM and FPS)

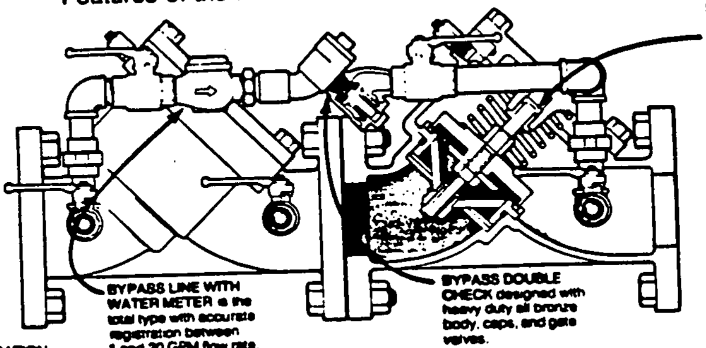
NOTES:
1. Velocities are calculated for flows in Schedule 40 steel pipe.

Features of the Model 806YD DCDA (3" thru 10")

LIGHTWEIGHT, DURABLE DURACAST DUCTILE IRON BODY DESIGN with internal epoxy coating. Resistant to damage caused by normal installation and operating conditions.

The DURACHECK ALL STAINLESS STEEL CHECK ASSEMBLY resists corrosion, prolongs valve life, and promotes reliable operation

SIMPLE SERVICE PROCEDURES all internal parts on main line and bypass double checks are serviceable in line



SPRING LOADED CENTER GUIDED CHECKS with soft elastomer discs provide tight closure against backflow. Delrin bushing is replaceable and facilitates check operation.

"Y" PATTERN VALVE DESIGN insures low head loss at high flow rates.

The WORKING PRESSURE of the Model 806 YD DCDA is 175 PSI. This rating adds an additional "safety factor" to help compensate for high water hammer pressures often experienced with water systems.

◌ DENOTES TEST COCK LOCATION

* AVAILABLE WITH RESILIENT SEATED OS & Y GATES.

Model 825Y Reduced Pressure Backflow Prevention Assembly (3/4" Thru 2")

The Model 825Y reduced pressure backflow prevention assembly consists of two independently operating, center guided, spring loaded, "Y" pattern check valves and one hydraulically dependent differential relief valve. The assembly automatically reduces the pressure in the "zone" between the check valves to at least 5 PSI lower than the inlet pressure.

If the differential between upstream and the zone of the unit drops to 2 PSI, the differential relief valve will open and maintain the proper differential.

Standard features of the Model 825Y include the "Y" body design for low pressure loss, reliable operation, and easy serviceability. At the typical design flow rates of 0 to 7.5 feet per second the 825Y has one of the lowest head losses in the industry.

Febco publishes flow charts obtained from independent laboratories.

The elementary yet efficient design of the Model 825Y provides consistent operation in the harshest water environments.

Operational water tests are performed on 100% of the 825Y assemblies before delivery to the field.

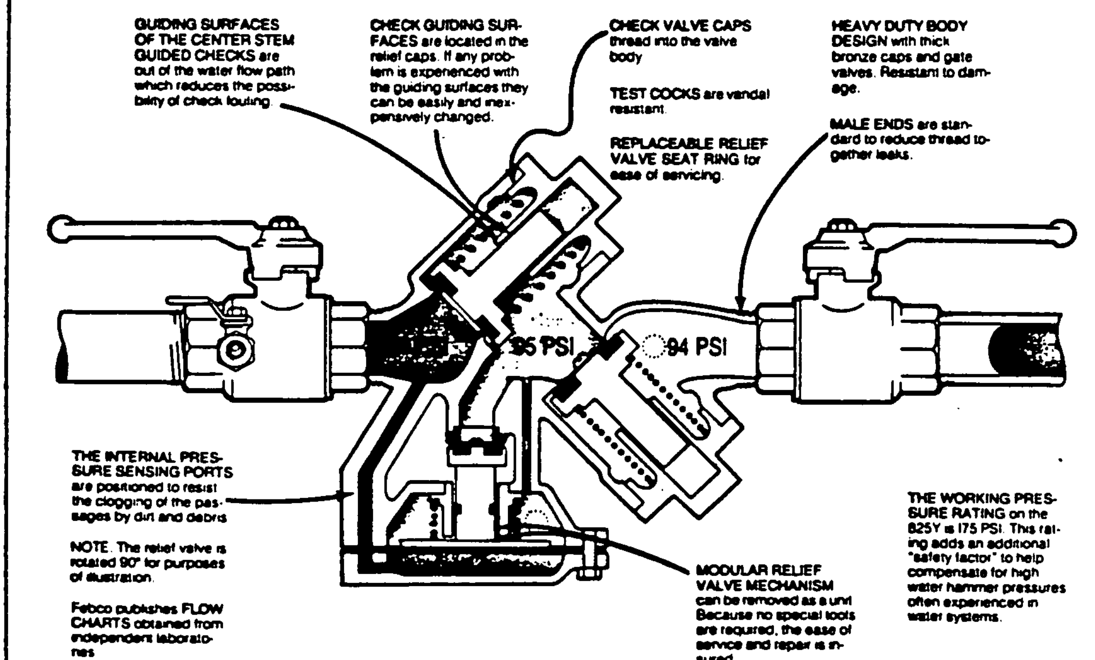
- Low head loss.
- Reversible seat discs.
- Replaceable relief valve seat ring.
- Available with air gap drain.

Model 825Y SELECTION CRITERIA:

- High hazard service.
- Continuous pressure operation.
- Possible backpressure.

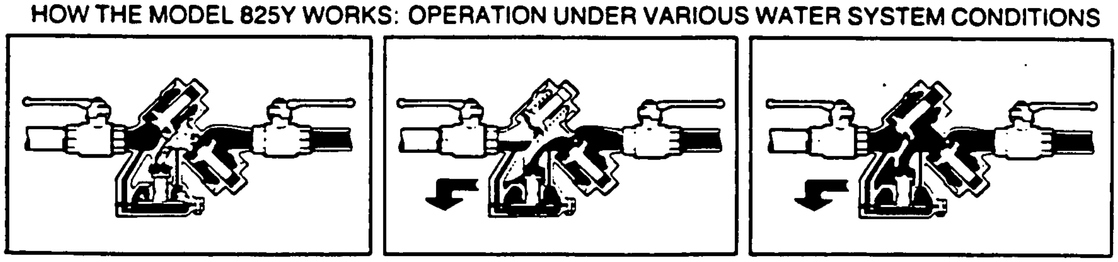
See page 3 for applicable approvals.

Features of the Model 825Y (3/4" thru 2")



* SHOWN WITH OPTIONAL BALL VALVE SHUT-OFFS. ⁝ DENOTES TEST COCK LOCATION

HOW THE MODEL 825Y WORKS: OPERATION UNDER VARIOUS WATER SYSTEM CONDITIONS



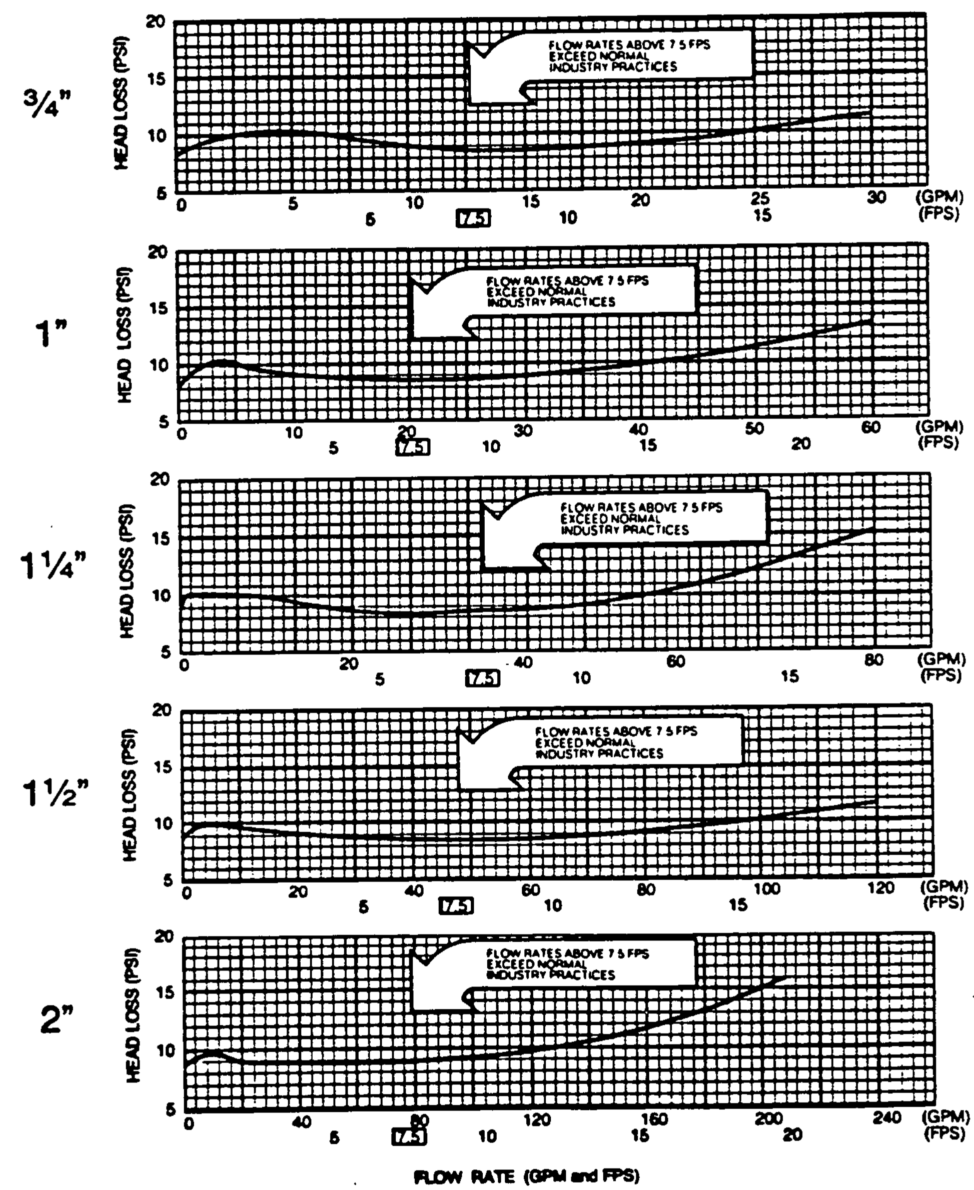
Normal Flow Condition

Backsiphonage Flow Condition (Both Check Valves Fouled)

Backpressure Flow Condition (Second Check Valve Fouled)

Model 825Y Flow Curves

(Flow Curves as established ... USC Foundation for Cross Connection Control and Hyd... Research)



NOTES:
1. Velocities are calculated for flows in Schedule 40 steel pipe.
2. Typical water system flow velocities of 0 to 7.5 FPS should be used for head loss efficiency comparisons.

NOW WITH STAINLESS STEEL DuraCheck®

Model 825YD Reduced Pressure Backflow Prevention Assembly (2½" Thru 10")

The Model 825YD reduced pressure assembly consists of two independent, "Y" type spring loaded check valves, a differential pressure relief valve mounted between the two checks, and three test cocks. An inlet test valve with a fourth test cock and an outlet shut-off valve are added to make a complete and serviceable assembly. In normal operation, the check valves are open with the pressure between the checks, called the zone, being maintained at least 5 PSI lower than the inlet pressure. The relief valve is maintained closed. Should abnormal conditions arise under backflow, the differential relief valve will open and discharge to maintain the zone at least 2 PSI lower than the inlet pressure; thus preventing contamination of the supply.

The elementary yet efficient design of the Model 825YD provides consistent operation in the harshest water environments.

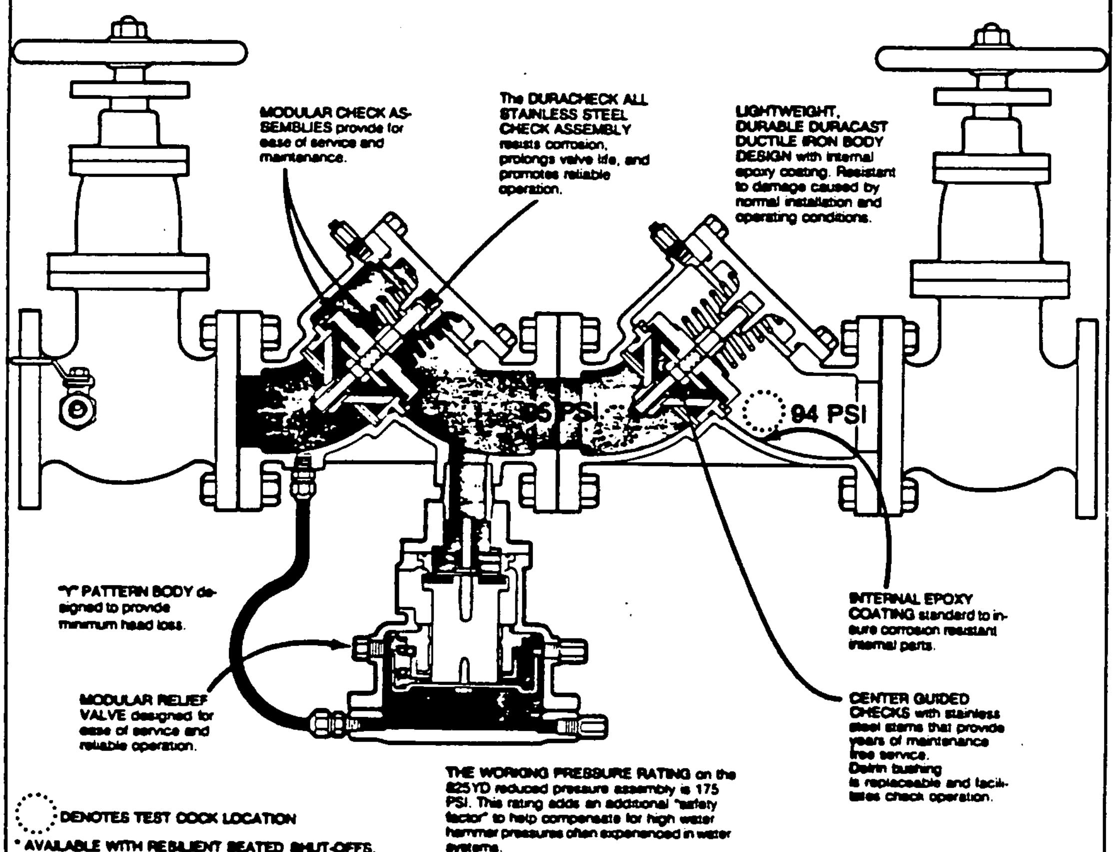
- **Ductile iron bodies.**
- **DuraCheck stainless steel check assembly.**
- **Modular relief valve.**
- **OS & Y gate valves on all UL/FM assemblies.**
- **Reversible seat discs.**
- **Resilient gate valves available upon request.**

Model 825YD SELECTION CRITERIA:

- High hazard service.
- Continuous pressure operation.
- Possible backpressure.

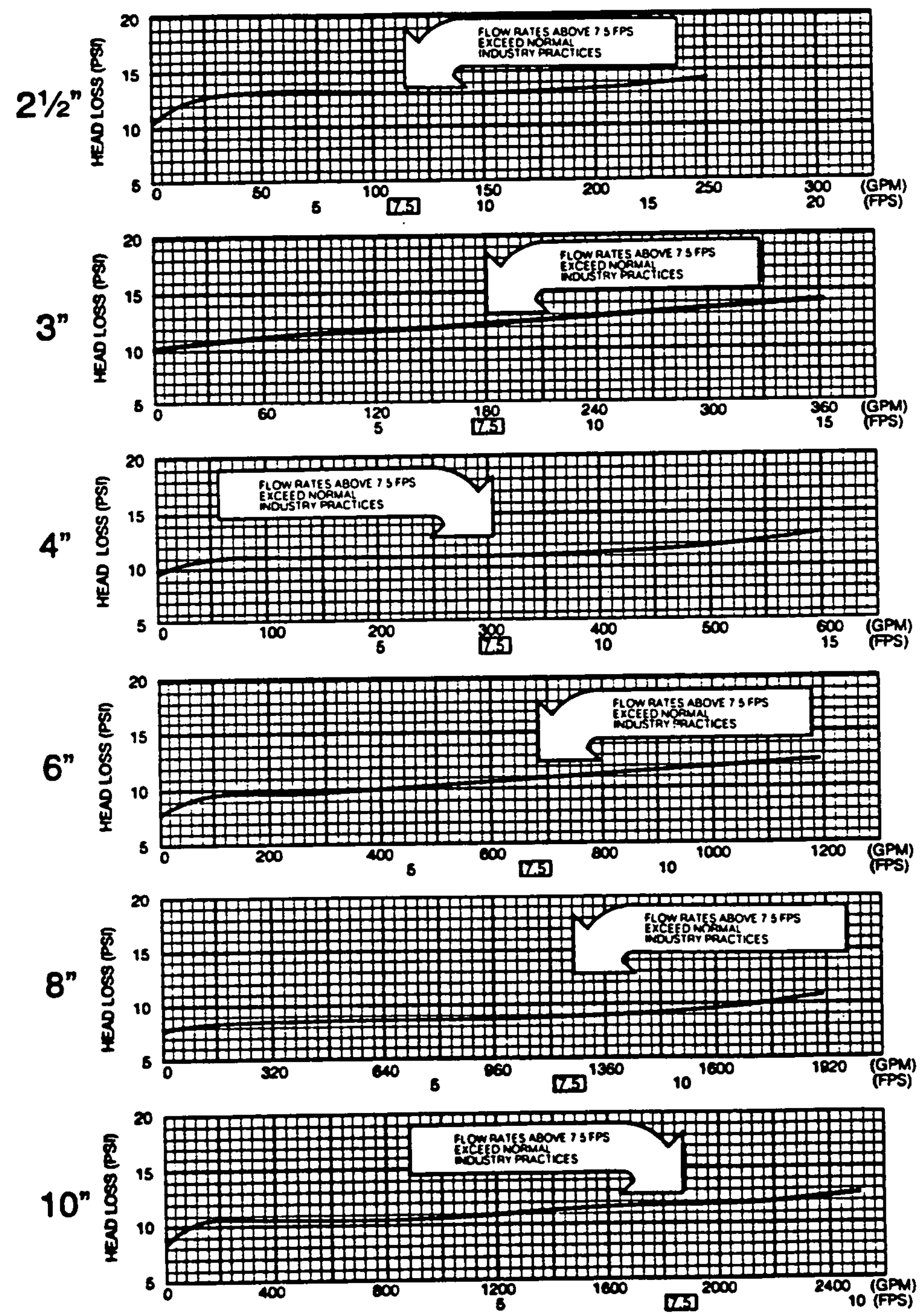
See page 3 for applicable approvals.

Features of the Model 825YD (2½" thru 10")



odel 825YD Flow Curves

(Flow Curves as established b... the USC Foundation for Cross Connection Control and Hydr... Research)



NOTES:

1. Velocities are calculated for flows in Schedule 40 steel pipe.

2. Typical water system flow velocities of 0 to 7.5 FPS should be used for head loss efficiency comparisons.

Model 826YD (2½", 3" & 4") and Model 825YD RPDA (6", 8" & 10") Reduced Pressure Detector Assy.

The Model 826YD and Model 825YD RPDA reduced pressure detector assembly consist of two independent mainline "Y" pattern center guided, spring loaded check valves. The bypass consists of two ball valves, a total type water meter, and a small 825Y assembly. In a non-flowing condition, the mainline check, bypass, and meter are closed and stopped. When the water begins to flow, the bypass check opens and the meter begins to register. When the bypass pressure loss approximates 3 PSI, the mainline check opens and allows full flow of water. The bypass meter and check remain operating and open at all flow rates above 0 GPM.

The Model 826YD and 825YD RPDA are designed for ease of service and long valve life.

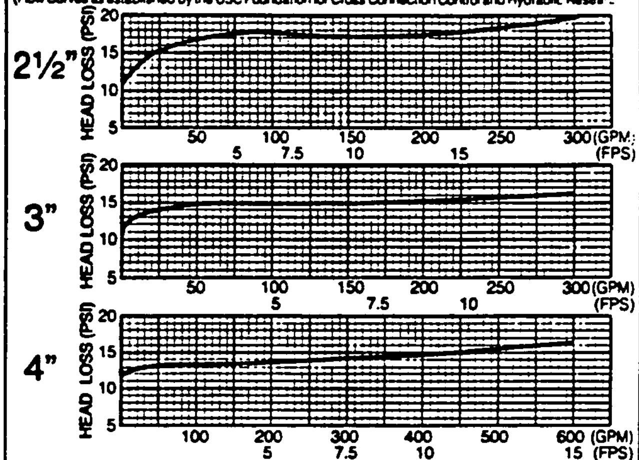
- Ductile iron bodies
- DuraCheck stainless steel check assembly
- Modular relief valve
- OS & Y gate valves

Model 826YD and Model 825YD RPDA SELECTION CRITERIA:

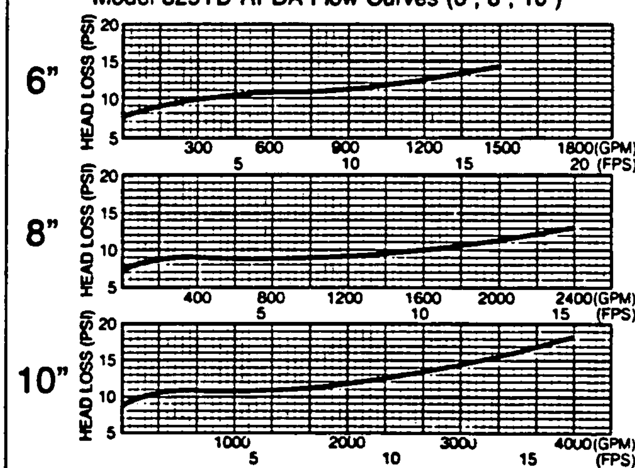
- High hazard service
- Continuous pressure operation
- Possible backpressure

Model 826YD Flow Curves (2½", 3", 4")

(Flow Curves as established by the USC Foundation for Cross Connection Control and Hydraulic Research)



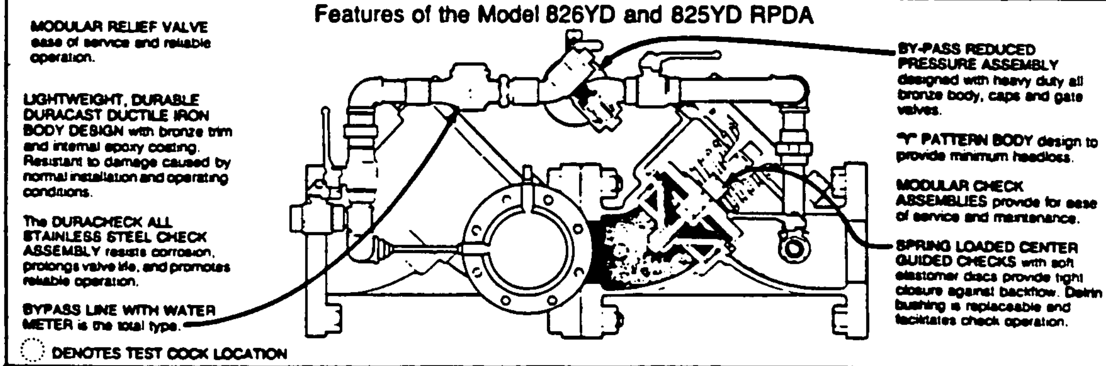
Model 825YD RPDA Flow Curves (6", 8", 10")



FLOW RATE (GPM and FPS)

NOTES:
1. Velocities are calculated for flows in Schedule 40 steel pipe.

Features of the Model 826YD and 825YD RPDA



Model 810 Dual Check Backflow Prevention Assembly (¾" & 1")

The Model 810 dual check backflow prevention assembly is designed to be installed downstream from the house water meter to reduce the potential backflow of pollutants from the house or yard into the water mains.

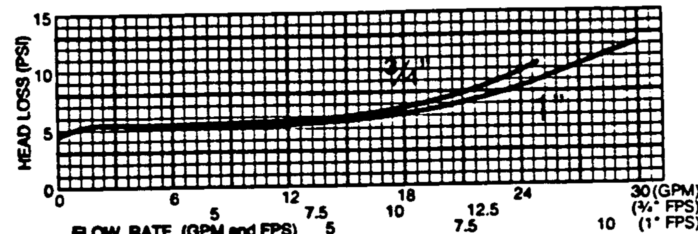
The Model 810 consists of two in-line, spring loaded, poppet type cartridges. The bronze body is constructed with a union connection for easy servicing. In normal operation the checks open with flow demand. During no-flow conditions, each check is designed to hold 1 PSI in the direction of the flow.

See page 3 for applicable approvals.

NOTE: ⅝",¾" & 1" meter connections also available.

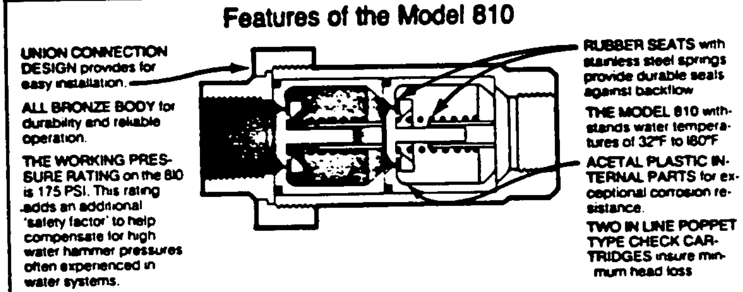
Model 810 Flow Curves

(Flow Curves as established by the Twining Labs. Inc.)



NOTES:
1. Velocities are calculated for flows in Schedule 40 steel pipe.
2. Typical water system flow velocities of 0 to 7.5 FPS should be used for head loss efficiency comparisons.

Features of the Model 810



Model 815 DCAP Dual Check with Atmospheric Port (½" & ¾")

The Model 815 DCAP dual check with atmospheric port is designed to protect against backsiphonage and backpressure in cold and hot water continuous pressure applications. The device can be used in low hazard applications such as boiler feed lines, non-toxic laboratory equipment installations, sterilizers, and other low hazard applications.

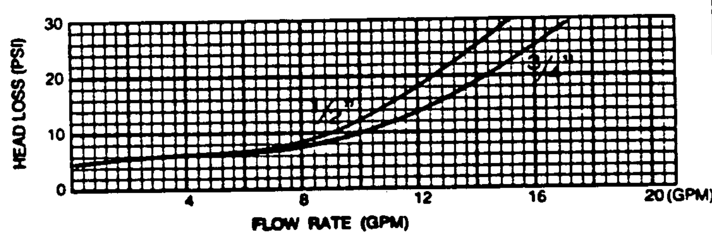
The Model 815 consists of two independendently operating check valves with an intermediate atmospheric port. In normal operation the checks open with flow demand. During no-flow conditions, each check is designed to hold 1 PSI in the direction of flow.

When a backsiphonage condition occurs the atmospheric port opens to permit air to break the siphon. In the event of backpressure and a fouled second check, leakage is vented through the atmospheric port.

See page 3 for applicable approvals.

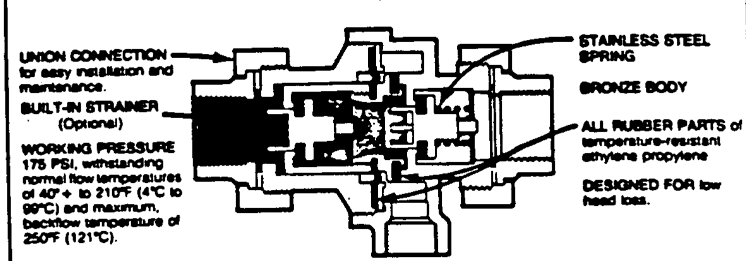
Model 815 DCAP Flow Curves

(Flow Curves as established by the Twining Labs. Inc.)



NOTE:
1. Velocities are calculated for flows in Schedule 40 steel pipe.

Features of the Model 815 DCAP



"Y" Strainers

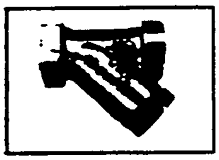
Uses of "Y" Strainers:

Strainers are designed to protect equipment from damage due to dirt, scale, debris, and other foreign materials. The strainer should be installed before backflow prevention devices, control valves, pumps, meters, and other equipment.

Typical Applications

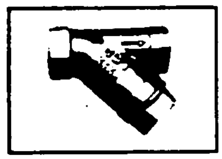
- Backflow prevention devices
- Control valves
- Pumps
- Motors
- Air lines
- Irrigation systems
- Water Heating Supply
- Industrial Process Equipment Supply

Model 3130 Cast Iron "Y" Strainer



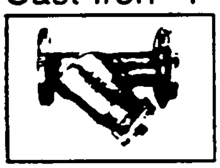
The Model 3130 consists of a cast iron body and cover and a stainless steel screen. The strainer includes body, cover, gasket and screen. The Model 3130 has IPS threaded ends, and is available with optional screen sizes. Working pressures—non shock: Steam 250 PSI (400° F); Water, oil and gas 400 PSI (100° F); Available in ½" through 2".

Model 3131 Bronze "Y" Strainer



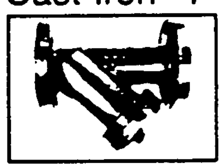
The Model 3131 consists of bronze body and cover and a stainless steel screen. The strainer includes body, cover, gasket and screen. The Model 3131 has IPS threaded ends and is available with optional screen sizes. Working pressures—non shock: Steam 300 PSI (400°F); Water, oil, and gas 400 PSI (100°F). Available in ½" through 2".

Model 3132 Cast Iron "Y" Strainer



The Model 3132 consists of cast iron body and cover and a stainless steel screen. The strainer includes body, cover gasket, screen, cover and capscrews. The model 3132 has 125# flanged ends and is available with optional screen sizes. Working pressures—non shock: Steam 125 PSI (400°F); Water, oil and gas 175 PSI (100°F). Available in 2½" through 12".

Model 3102 Cast Iron "Y" Strainer



The Model 3102 consists of cast iron body and cover and a stainless steel screen. The strainer includes body, cover gasket, screen, cover and capscrews. The model 3102 has 250# flanged ends and is available with optional screen sizes. Working pressures—non shock: Steam 250 PSI (400°F); Water, oil and gas 400 PSI (100°F). Available in 2½" through 12".

Model AGD Air Gap Drain

Description

The air gap drain Model AGD-Y is designed to be installed under the 825Y (¾" through 2") and the Model AGD-L is designed for installation under the 825 (2½" through 10"). The device catches minor relief valve discharge due to pressure fluctuations and/or minor check valve fouling.

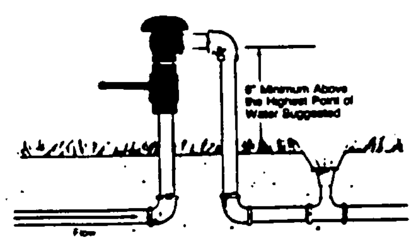
The drain may be either installed with support straps attached to the reduced pressure dump valve or for approved air gap installations, threaded on top a fully supported drain pipe

NOTE: The air gap drain is not designed to catch the maximum flows possible from the reduced pressure devices. Water line pressure, size and length of drain piping limits the amount of water handled by the AGD system.

Standard Installation Information for the Field

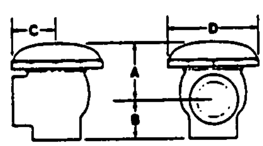
ATMOSPHERIC VACUUM BREAKER
Model 710 ½" through 2"

Install on the discharge side of the last shut-off valve. Install a minimum of 6" above the highest overflow level, with the air inlet in a level position.



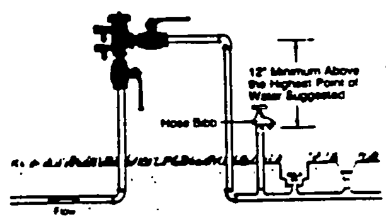
Dimensions and Weights

SIZE	A	B	C	D	WT. (LBS.)
½"	1¼"	1¼"	1¼"	2⅛"	¾
¾"	1½"	1⅜"	1⅜"	2½"	1
1"	2¼"	1¾"	1½"	3¼"	1¾
1¼"	2¼"	1⅝"	2"	4"	2½
1½"	2½"	2¼"	2¼"	4½"	3¾
2"	3¼"	2¼"	2¼"	5½"	5¼



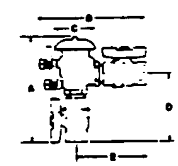
PRESSURE VACUUM BREAKER ASSEMBLY
Model 765 ½" through 2"

Install at least 12" above the highest piping or outlet downstream of the device and in a manner to preclude backpressure. Install for easy accessibility for testing and maintenance purposes. Locate where discharge will not be objectionable. Protect from freezing. Must not be installed where backpressure may occur. Discharge pressure should be maintained above 3.0 PSI on the ½" through 1¼" sizes and above 5.0 PSI in the 1½" and 2" sizes.



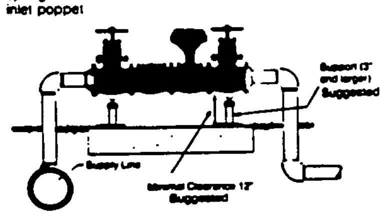
Dimensions and Weights (with Ball Valve Shut-offs)

SIZE	A	B	C	D	E	WT.(LBS.)
½"	6¼"	6¾"	2½"	3¾"	4¼"	2.6
¾"	6½"	7"	2½"	4"	4½"	2.9
1"	8¾"	9"	4"	5¼"	6"	5.9
1¼"	9¼"	10"	4"	6¼"	7"	7.0
1½"	11¾"	11½"	6½"	7½"	7¾"	14.8
2"	12½"	12¼"	6½"	8"	8½"	16.5



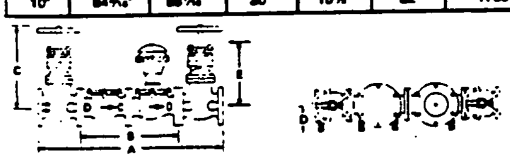
PRESSURE VACUUM BREAKER ASSEMBLY
Model 775 3" through 10"

Install at least 12" above the highest piping or outlet downstream of the device and in a manner to preclude back pressure. Install for easy accessibility for testing and maintenance purposes. Locate where discharge will not be objectionable. Protect from freezing. Must not be installed where back-pressure may occur. Discharge pressure shall be maintained above 5.0 PSI to insure seating of the spring loaded air inlet poppet.



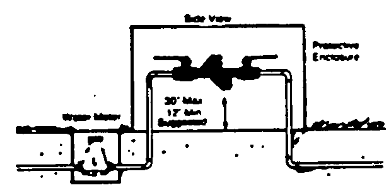
Dimensions and Weights

SIZE	A	B	C	D	E	WT. (LBS.)
3"	34½"	18¼"	14⅝	6¼"	10⅛	222
4"	38¼"	19⁹⁄₁₆"	16½"	6½"	11¼"	307
6"	59¹¹⁄₁₆"	39⁵⁄₁₆"	21¼"	8¼"	14"	755
8"	69³⁄₁₆"	46¹⁄₁₆"	26"	9½"	18"	1250
10"	84⁵⁄₁₆"	58¹⁄₁₆"	30"	10¼"	22	1700



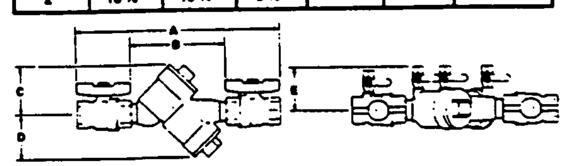
DOUBLE CHECK BACKFLOW PREVENTER
Model 805Y ¾" through 2"

Install with adequate clearance and easy accessibility for testing and maintenance purposes. Protect from freezing. Install horizontally or vertically with flow up.



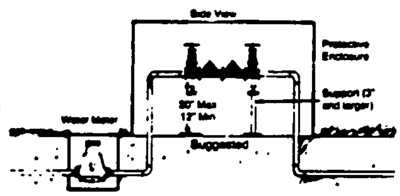
Dimensions and Weights (with Ball Valve Shut-offs)

SIZE	A	B	C	D	E	WT. (LBS.)
¾"	11⅝"	6⅞"	3¾"	3¾"	2⅛"	7
1"	12⅞"	6⅞"	3¾"	3¾"	2¼"	7½
1¼"	17¼"	10¼"	5⅛"	4¼"	3⅝"	17½
2"	18⅝"	10¼"	5¼"	4¼"	3¾"	20



DOUBLE CHECK BACKFLOW PREVENTER
Model 805YD 2½" through 10"

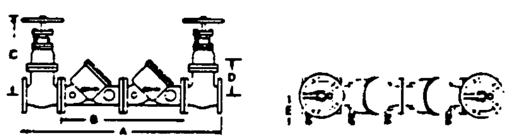
Install with adequate clearance and easy accessibility for testing and maintenance purposes. Protect from freezing. Install horizontally or vertically with flow up. Larger sizes should be installed horizontally for ease of service, and should have support blocks to prevent flange damage.



Dimensions and Weights

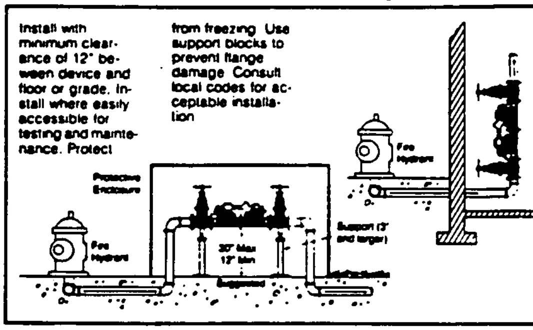
SIZE	A	B	C*	D	E	WT.(LBS.)
2½"	37 3/16"	22 1/16"	12⅛"	7⅛"	5¼"	230
3"	41 11/16"	25 9/16"	14"	8 1/16"	6"	240
4"	50 7/16"	32 9/16"	17⅜"	11"	6¾"	390
6"	59 11/16"	38 9/16"	21¼"	14"	8¼"	675
8"	69 3/16"	46 1/16"	26"	18"	9½"	1130
10"	84 3/16"	58 1/16"	30"	22"	10½"	1530

* Dimensions apply to NRS gate valve only.



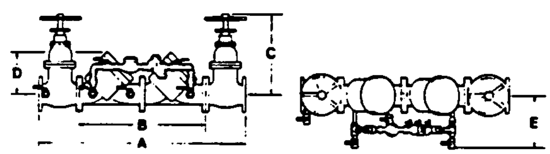
DOUBLE CHECK DETECTOR ASSEMBLY
Model 806YD DCDA 4" through 10"

Install with minimum clearance of 12" between device and floor or grade. Install where easily accessible for testing and maintenance. Protect from freezing. Use support blocks to prevent flange damage. Consult local codes for acceptable installation.



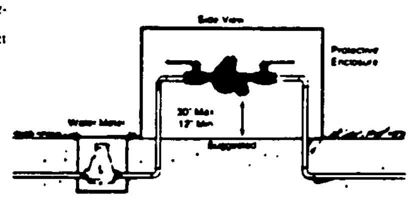
Dimensions and Weights

SIZE	A	B	C	D	E	NET WT.(LBS.)	NET WT.(LG.)
4"	50 7/16"	32 9/16"	23¾"	11"	15"	499	196.3
6"	59 11/16"	38 9/16"	32½"	14"	16"	812	308.3
8"	69 3/16"	46 1/16"	41⅞"	18"	17"	1307	492.9
10"	84 3/16"	58 1/16"	50½"	22"	20"	1767	651.5



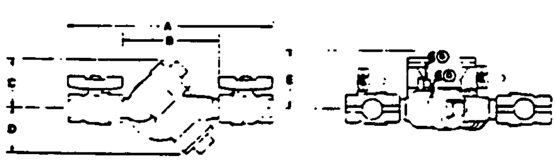
REDUCED PRESSURE BACKFLOW PREVENTER
Model 825Y ¾" through 2"

Install with minimum clearance of 12" from the port, floor, or grade. Install for easy accessibility. Protect from freezing. Majority of local codes restrict pit installations.



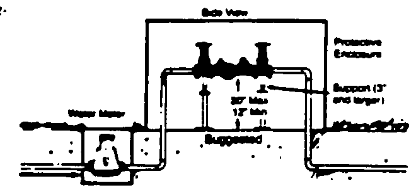
Dimensions and Weights (with Ball Valve Shut-offs)

SIZE	A	B	C	D	E	WT.(LBS.)
¾"	12¼"	7¾"	4⅛"	3¼"	4⅛"	11⅛
1"	13⅜"	7¾"	4¼"	3¼"	4¼"	12½
1¼"	14¼"	7¾"	4⅛"	3¼"	4⅛"	14
1½"	18¼"	10¾"	6¼"	4½"	5"	26½
2"	19"	10¾"	6¼"	4½"	5"	29



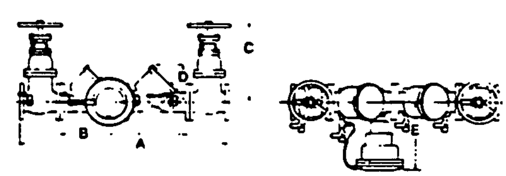
REDUCED PRESSURE BACKFLOW PREVENTER
Model 825YD 2½" through 10"

Install with minimum clearance of 12" from the port, floor, or grade. Install for easy accessibility. Protect from freezing. Use support blocks to prevent flange damage. Majority of local codes restrict pit installation.



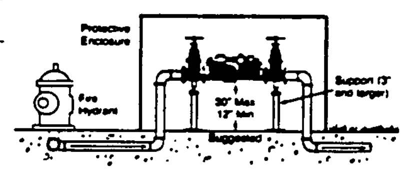
Dimensions and Weights

SIZE	A	B	C	D	E	WT.(LBS.)
2½"	37 3/16"	22 1/16"	12¼"	7⅛"	11"	260
3"	41 11/16"	25 9/16"	14"	8 1/16"	12"	295
4"	50 7/16"	32 9/16"	17⅜"	11"	13"	460
6"	59 11/16"	38 9/16"	21¼"	14"	15"	800
8"	69 3/16"	46 1/16"	26"	18"	16"	1150
10"	84 3/16"	58 1/16"	30"	22"	17"	1570



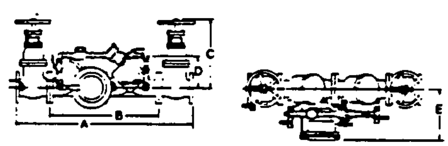
REDUCED PRESSURE DETECTOR ASSEMBLY
Models 826YD (2½", 3" and 4") and 825YD RPDA (6", 8" and 10")

Install with adequate clearance and easy accessibility for testing and maintenance purposes. Protect from freezing. Install horizontally. Larger sizes should have support blocks to prevent flange damage.



Dimensions and Weights

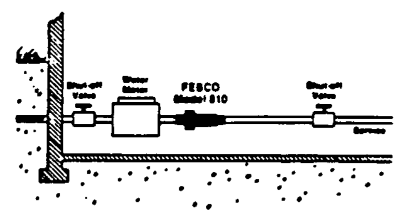
SIZE	A	B	C	D	E	NET WT.(LBS.)	NET WT.(LG.)
4"	50 7/16"	32 5/16"	23 ¾"	11"	13"	469	194
6"	59 11/16"	38 9/16"	32 ⅝"	14"	15"	752	397
8"	69 9/16"	46 1/16"	41 ⅞"	18"	16"	1207	537
10"	84 3/16"	58 1/16"	50 ½"	22"	17"	1617	957



DUAL CHECK VALVE
Model 810 ¾" and 1"

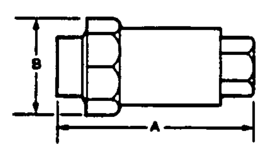
Thoroughly flush service line before installing in any position

Install horizontally or vertically with flow up. Allow adequate distance from grade or floor for maintenance and testing. Protect from freezing.



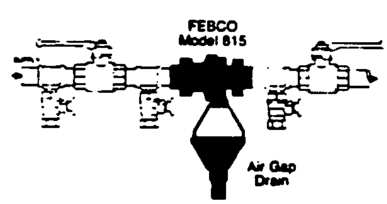
Dimensions and Weights

SIZE	A	B	WT. (LBS.)
⅝", ¾" & 1"	4⅝"	2⅜"	1½



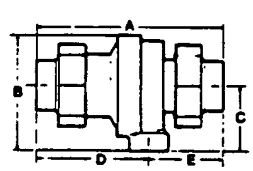
DUAL CHECK with ATMOSPHERIC PORT
Model 815 DCAP ½" and ¾"

Install with minimum clearance of 12" between device and floor grade. Install where easily accessible for testing and maintenance. Should not be installed where discharge from port will be objectionable



Dimensions and Weights

SIZE	A	B	C	D	E	WT.(LBS.)
½" & ¾"	5"	3⅛"	1¾"	3"	1⅞"	2½"



FEBCO®

Engineered

Febco... Backflow Prevention Assemblies designed to minimize head loss.

Febco is committed to provide engineers, architects, contractors and backflow device users the clearest information posssible regarding product performance.

Our flow curves are designed to help you evaluate the performance of our products in water systems typical to your markets. That's why we emphasize the use of head loss amounts at water flow rates typically used in the plumbing, irrigation, and city water works markets.

Febco now emphasizes the "typically used" flow rates because of feedback from the field that the qualifying "Rated Flow" headloss amounts, established years ago in the development of the backflow industry, do not have any relationship with the actual water flow rates utilized in the plumbing, irrigation, and city water works markets.

"Rated Flow" head loss amounts for Backflow Preventers were based on the maximum allowable flow rate in gallons through a similar sized water meter. The rate of flow through the water meter determined the standard, not the performance of the backflow device in the water system itself.

Typical water flow velocities utilized within these markets range form 0 and 7.5 FPS. The maximum of 7.5 FPS was established because of possible damage from water hammer that can occur to the water system components.

We are aware that some Backflow Prevention manufactures do not indicate the importance of remaining below 7.5 FPS flow velocity on their performace curves. In fact, some indicated head loss rates at velocities which are more than double those typical of the industry.

Febco is hopeful that the design of our flow curves is helpful to you in your work. And, they are obtained from independent laboratories.

Febco produces the widest selection of Backflow Prevention Assemblies approved by the University of Southern California Foundation of Cross-Connection Control and Hydraulic Research and by the American Society of Sanitary Engineering. When using a Febco product, you are insured of not only Febco's standard of excellence, but standards set by independent testing groups.

In the flow curves below, ***50 GPM in a 1" pipeline is a velocity of 18 FPS***. Rated Flow as established by USC in a 1" backflow preventer is ***50 GPM*** which ***exceeds industry practices of 7.5 FPS***.

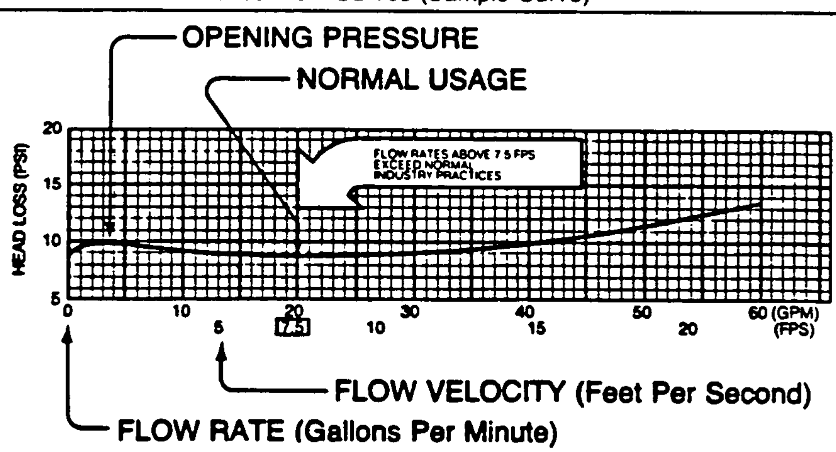
Features of the Febco Flow Curves (Sample Curve)

PIPE MANUFACTURERS DO NOT RECOMMEND EXCEEDING 7.5 FPS because of possible damage from water hammer. Febco flow charts specify the exact location of 7.5 FPS on each curve.

FEBCO FLOW CURVES indicate the typical flow velocity for each specific device.

FLOW CURVES ARE ESTABLISHED BY INDEPENDENT LABORATORIES, either USC Foundation for Cross-Connection Control and Hydraulic Research or the Twining Laboratories, Inc.

Graph illustration both FEET PER SECOND (FPS) and GALLONS PER MINUTE (GPM).



NOTES:

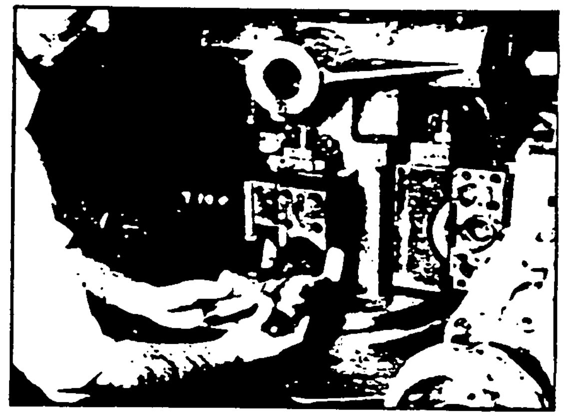
1. Velocities are calculated for flows in Schedule 40.
2. Typical water system flow velocities of 0 to 7.5 FPS should be used for head loss efficiency comparisons.

Engineered Products that Perform

Febco produces thousands of backflow prevention assemblies each year. Computerized production systems, precise inventory control technique, sophisticated engineering and design, strong, responsive management, expert craftsmen, and well-planned assembly methods all combine to produce backflow prevention devices of superior quality.

Febco engineers continually upgrade present products and design new products to keep current with the needs of the marketplace. They readily convert the recommendations of the sales force to the manufacture of backflow assemblies that meet customer demands. This translates to products that provide:

- Low head loss
- Reliable operation
- Easy serviceablity



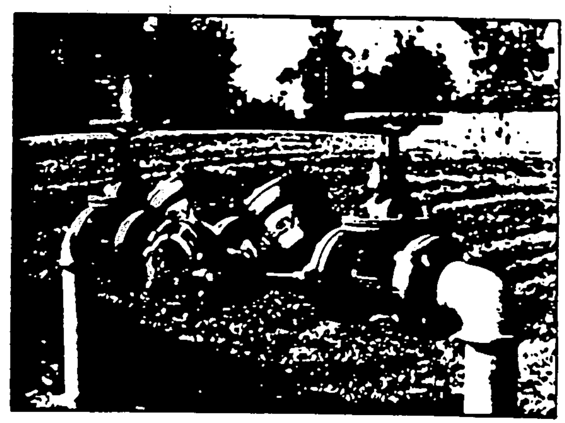
Quality Control

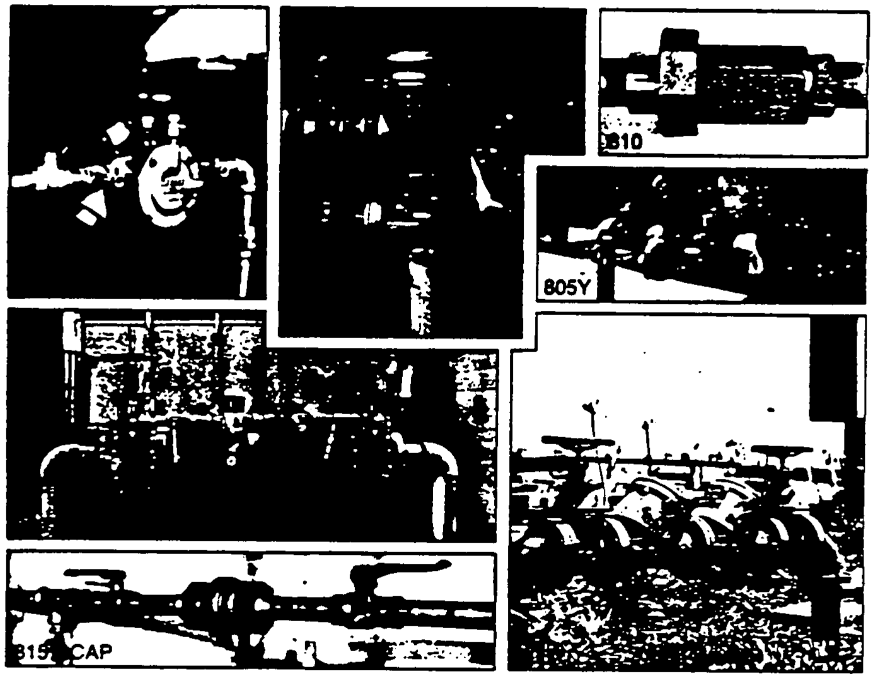
100% product testing is performed before any Febco product is shipped from the factory. The actual tests performed utilize the same criteria established by approving agencies. Febco's continuous in-process quality control inspections help provide the reliable operation of all Febco backflow prevention assemblies. All parts purchased from outside vendors are inspected in accordance with Military Standard 105D.

Serviceability

Febco's efficient yet simple designs provide easy to maintain assemblies for trouble-free service, eliminating troublesome call backs in the field. All internal parts can be serviced without removing the assemblies from the line.

Febco has the widest line of approved backflow prevention assemblies in the industry. Approving agencies include the University of Southern California Foundation for Cross Connection Control and Hydraulic Research, the American Waterworks Association and the American Society of Sanitary Engineers.





Febco Backflow Prevention Assemblies

For a quarter of a century Febco has been in the business of producing quality backflow prevention assemblies for the irrigation, industrial, plumbing and city water works industries throughout the world.

And, today, they continue to produce the finest backflow prevention assemblies with the ultimate in backflow design insuring low head loss, reliable operation, and ease of service in the field.

Approving agencies include the University of Southern California Foundation for Cross Connection Control and Hydraulic Research, The American Waterworks Association, the American Society of Sanitary Engineering, Canadian Standards Association, the Southern Building Code Congress, Underwriters Laboratory, and Factory Mutual.

Febco provides data regarding flow curves and performance that is accurate and is the only backflow preventer manufacturer to supply verification of that performance by independent testing laboratories.

BAILEY CONTROL VALVES

Another division of CMB Industries, Bailey produces a wide line of quality control valves, duplex and simplex strainers and polyjets. Bailey's heavy-duty valves are designed in both standard and special materials allowing control of water, petroleum products and other liquids in a wide range of applications.

CMB "Y" TYPE STRAINERS

CMB Industries also has a line of commercial grade "Y" type strainers for use whenever protection of equipment from foreign material is desired.

For more information on how Febco can provide your project or installation with the latest in Backflow Prevention technology, call or write:

FEBCO®

A division of CMB Industries
P.O.Box 8070, Fresno, California 93747
(209) 252-0791 Telex: 33-7616 CMB FSO Fax: (209) 453-9030

GPC 2/89

AMES CO.

INSTALLATION
MAINTENANCE
and PARTS MANUAL
for
BACKFLOW PREVENTION ASSEMBLIES

Double Check Assembly Model #2000 DCA
Double Detector Check Assembly Model #3000 DCDA
Reduced Pressure Principle Backflow Assembly Model #4000 RP
Reduced Pressure Principle Backflow Detector Assembly Model #5000 RPDA

[illegible] • [illegible] Ave • P.O. Box 1387 • Woodland, CA 95695 • (916) 666-2493

MAINTENANCE INSTRUCTIONS:

Ames backflow prevention assemblies require minimum maintenance. Maintenance on all internal components can be performed without removal of the assembly from line service. All assemblies must be retested once maintenance has been performed.

Removing and Installing Knuckle Joint Assembly 2000 DCA & 3000 DCDA

1. Shut down water system and lockout system if possible.

2. Slowly open test cocks or air bleed screw to relieve pressure.

3. Remove all cover plate bolts, lid and cover plate gasket from valve body.

4. Push retainer clip into knuckle joint retention openings located on inner and outer linkages of knuckle joint assembly, until clapper opens slightly. (Drawing 1).

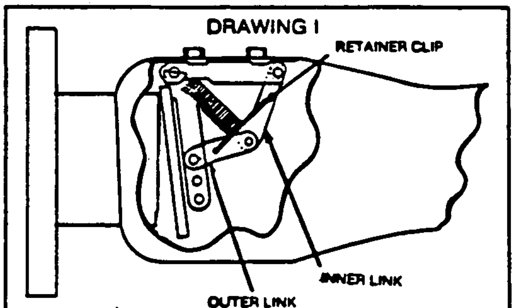
5. Carefully loosen and remove the two knuckle joint mounting bolts, located on exterior of valve body.

6. Remove knuckle joint from body assuring retainer clip is not disturbed.

7. Bolt the old knuckle joint assembly on the exterior of the body through the mounting link holes (Drawing II), or press on hard surface to remove retainer clip.

8. Push on clapper plate to release retainer clip, and remove clip. Slowly remove tension on clapper and unbolt knuckle joint assembly from mounting link holes.

DRAWING I

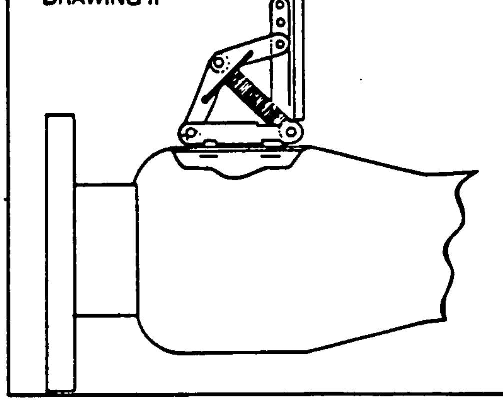


9. Bolt replacement knuckle joint assembly as in step 7.

10. Push on clapper plate to extend springs and install retainer clip. Unbolt knuckle joint assembly from mounting link holes.

11. Insert two New ⅜ x 1" o-ring sealed mounting bolts through mounting holes in body. Position knuckle joint in place inside body, and finger tighten both bolts.

DRAWING II



12. Torque knuckle joint mounting bolts to approximately 10 FT LBS.

13. Remove retainer clip.

14. Install new gasket and lid. Torque lid bolts to 120 FT LBS.

Removing And Installing Knuckle Joint Assembly (#1 check valve on 4000 RP, 1st and 2nd check on 10" 2000 DC & 3000 DCDC).

1. Depressurize assembly.

2. Remove all cover plate bolts, cover and gasket from #1 check.

3. Locate pivot arm of tong tool onto horizontal link pin of knuckle joint (Drawing III).

4. Locate pivot arm of tong tool into adjacent port flange hole.

MAINTENANCE IN TRUCTIONS

5. Remove the two rear mounting nuts from exterior of body.

6. While depressing tong tool handle, work rear mounting link away from port tube. (Caution: considerable tension is on tong tool hold firmly).

7. Slowly release controlled pressure on tong tool handle until tension is relieved from springs.

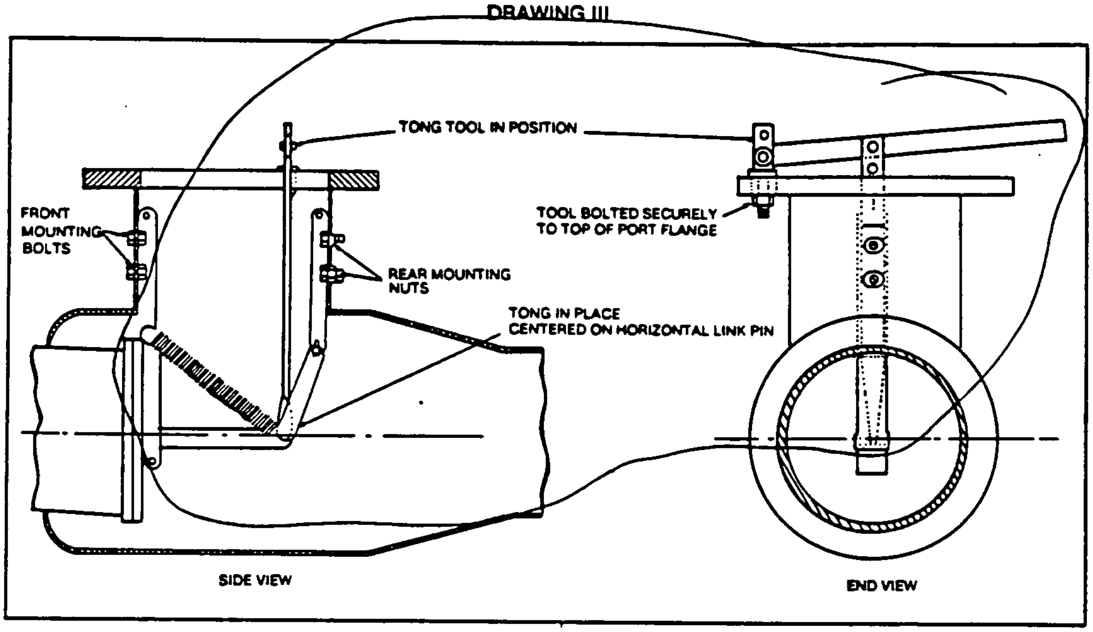
8. Remove tong tool from device.

9. Remove 2 - ⅜" mounting bolts from front of body.

10. Remove knuckle joint assembly from body.

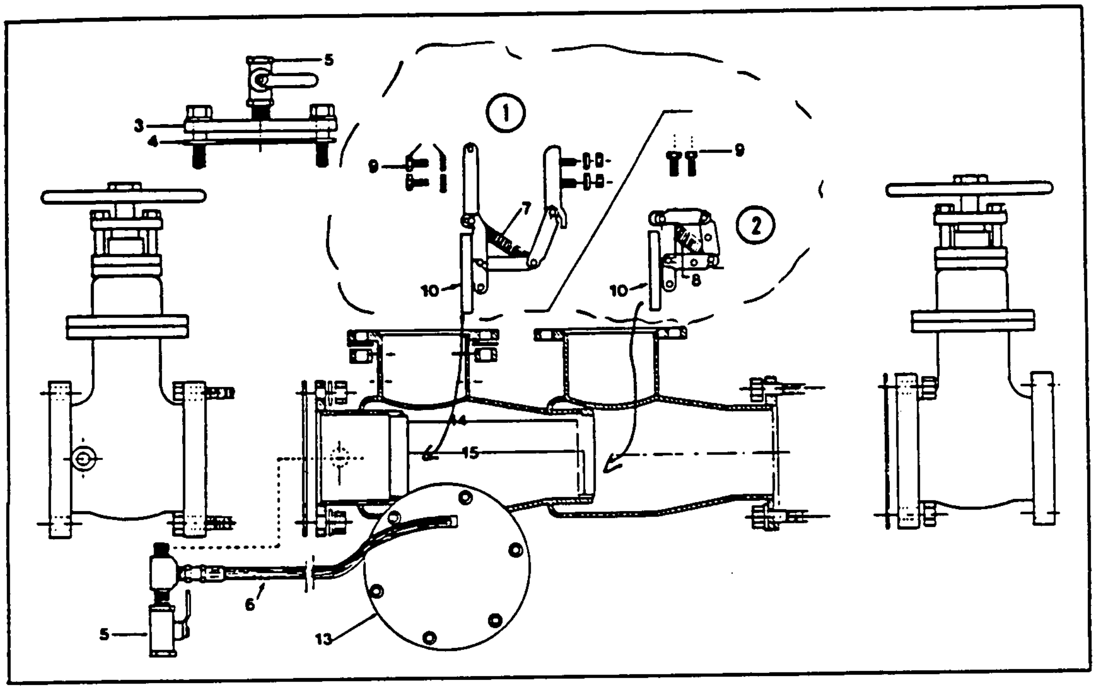
11. Reinstall new knuckle joint assembly by reversing above procedure.

DRAWING III



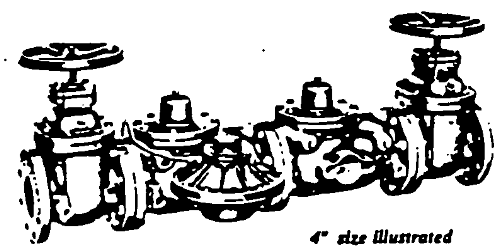
PARTS

Reduced Pressure Principle Backflow Prevention Device Parts List



ITEM NO.	DESCRIPTION	QTY.	SIZE 4"	SIZE 6"	SIZE 8"	SIZE 10"
1	1st knuckle joint assembly	1	3-759	3-775	3-854	3-854
2	2nd knuckle joint assembly	1	3-751	3-789	3-863	3-863
3	Bonnet flange	2	3-1164	3-1177	3-1188	3-1188
4	Bonnet Gasket	2	3-747	3-533	3-534	3-534
5	Test cock	3	980-527	980-449	980-449	980-449
6	Braided hose	1	980-498	980-498	980-498	980-498
7	1st knuckle joint assembly springs		(2) 3-986	(3) 3-987	(5) 3-985	(5) 3-985
8	2nd knuckle joint assembly springs		(2) 3-989	(2) 3-591	(3) 3-990	(3) 3-990
9	3/8" stainless steel housing bolts (2 per knuckle joint assembly)	2	980-520	980-520	980-520	980-520
10	Vulcanized clapper plate	1	3-1146	3-1147	3-1148	3-1148
11	Bronze seat ring (not shown)	2	3-701	3-703	3-705	3-705
12	Seat o-ring (not shown)	2	3-702	3-704	3-706	3-706
13	Relief valve (see pg. 14)	1	3-937	3-937	3-937	3-937

Model RP-1 BA-KFLOW PREVENTER . . .



4" size Illustrated

REDUCED PRESSURE PRINCIPLE

The Clayton RP-1 Backflow Preventer protects potable water against contamination. This device combines maximum protection against backflow with exceptionally low head loss characteristics. It operates on the reduced pressure principle, which is an accepted method of safeguarding potable water supplies against the hazards of cross connections.

The Clayton RP-1 assembly is carefully constructed of corrosion resisting materials. It consists of two independently acting Toggle Lever Check Valves, an automatic Pressure Differential Relief Valve located between the two check valves, two shut-off valves and four test cocks.

Field testing is easily performed by means of the test cocks.

It is recommended that this unit be installed in a horizontal position.

OPERATION

When a normal flow condition exists, both Check Valves are open and the Pressure Differential Relief Valve is closed. No pressure adjustments are required. The unit operates efficiently at either high or low pressure. The Flow Chart, opposite page, graphically shows the slight pressure drop obtained at rated flow.

When flow ceases, pressure in the zone between the Check Valves is maintained at 2 psi lower than inlet pressure. Should inlet pressure drop to 2 psi or less, the Pressure Differential Relief Valve opens the zone to atmosphere.

When outlet pressure exceeds inlet pressure, both Check Valves and the Pressure Differential Relief Valve are tightly closed (no backflow can occur). However, to maintain the zone pressure at 2 psi less than the inlet pressure, the Pressure Differential Relief Valve opens momentarily if the inlet pressure drops below the 2 psi differential. After the required differential is established, the Pressure Differential Relief Valve again closes.

TOGGLE LEVER CHECK VALVES . . .

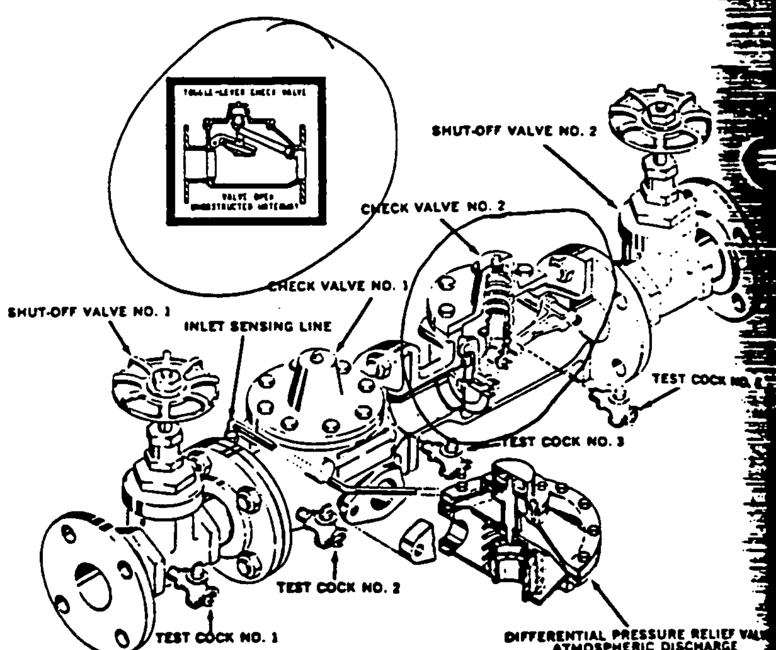
These valves are uniquely designed to provide drip tight closure against reverse flow and low pressure drop at maximum capacity. The spring-loaded toggle causes the valve to seal against a higher inlet pressure than outlet pressure when there is no flow.

The toggle lever system is designed so the mechanical advantage of the toggle is maximum in the closed position. Spring force required is relatively low in this position. As the valve opens to permit flow, the mechanical advantage reduces rapidly so a very low pressure drop is incurred at high flow rates.

The levers, links, and pins are rugged, simple, and direct, with ample clearances to insure long, trouble-free operation, even in very hard water and over prolonged periods of time. All internal parts are readily accessible without removing valves from the line.

FEATURES

- Positive operation
- Cannot cause water hammer
- Has no cavities to entrap foreign material
- No internal or external weights
- Has no sliding surfaces to gall or corrode
- All internal parts are removable
- All parts corrosion resistant



PRESSURE DIFFERENTIAL RELIEF VALVE . . .

This valve is a balanced differential valve which opens on a decreasing differential. It is closed whenever the inlet pressure is 2 to 3 psi higher than the zone pressure. When the difference in pressure is less than 2 psi, the valve begins to open and will continue to open wider as the differential decreases. Thus, the zone pressure is maintained less than the inlet pressure until inlet pressure reaches atmospheric pressure, at which time the differential relief valve is wide open.

This valve is fully balanced under both static and flowing conditions and at low or high line pressures. This means it always operates the same on any line pressure within the specified pressure range.

CAUTION: PROVISION FOR ADEQUATE DRAINAGE MUST BE PROVIDED.

FEATURES

- Positive automatic operation
- Vents provide visible evidence if internal damage occurs
- Single seat . . . tight shutoff . . . resilient disc
- Valve outlet cannot be interconnected or plugged
- All parts corrosion resistant

...m Head Loss . . . Maximum Backflow Prevention . . .

RP-1

All sizes without shut-off valves are classified by Underwriter's Laboratories. When used in fire service OS & Y Shut-off Valves must be used.

...ASE SPECIFICATIONS

...ed pressure principle backflow preventer shall be a ...ssembly consisting of two independently acting spring-...gle lever check valves together with an automatically ... pressure differential relief valve located between the ... valves. The first check valve shall reduce the supply ... predetermined amount so that during normal flow and ...tion of normal flow, the pressure between the checks is ... the supply pressure. In the case of leakage of either ...lve, the differential relief valve shall discharge to atmos-... maintain the pressure between the checks, less than the ...ressure.

This unit shall include tightly closing shutoff valves located at each end of the device, and shall be fitted with properly located test cocks. Operation shall be completely automatic. All internal parts of the toggle lever check valves and pressure differential relief valve must be removable or replaceable without removal of the reduced pressure principle backflow preventer from the line. The total head loss through the complete backflow assembly shall not exceed 10 psi at the "rated flow".* The reduced pressure principle backflow preventer shall be similar in all respects to the Clayton RP-1 Backflow Preventer as manufactured by Cla-Val Co., Newport Beach, California, or approved equal.

*Values adopted by the American Water Works Association and the New England Water Works Association.

SPECIFICATIONS

SIZES	2"- 10"
END DETAIL	125 ANSI
...UM WORKING PRESSURE	150 PSI
...ROSTATIC TEST PRESSURE	300 PSI
TEMPERATURE RANGE	to 110°F
FLUID	Water
MATERIAL	*2" main valve body and cover:* Bronze ASTM B-61 *2½" and larger main valve body and cover:* Cast Iron ASTM A-126 interior epoxy coated *Main valve trim:* Bronze ASTM B-61 *Differential relief valve:* Bronze ASTM B-61 with Stainless Steel 316 Trim

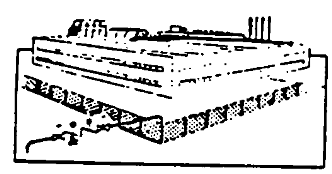
TYPICAL APPLICATIONS

INDUSTRIAL PLANTS

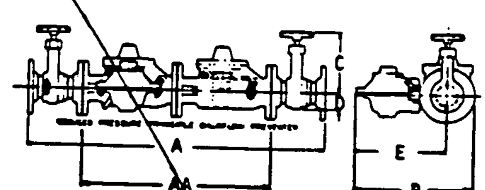
Water supplies to industrial concerns of all kinds must have adequate backflow protection to prevent plant water, which may be contaminated, from returning to public mains.

PIER AND DOCK HYDRANTS

At dockside to prevent shipboard water from being returned to drinking water lines.



DIMENSIONS



CLASSIFIED BY UNDERWRITERS LABORATORIES, INC.®, AS TO FRICTION LOSS AND BODY STRENGTH ONLY.

...OW CHART

PRESSURE LOSS AT RATED FLOW*

...ues adopted by the AMERICAN WATER WORKS ASSOCIATION and the NEW ENGLAND WATER WORKS ASSOCIATION

VALVE SIZE IN INCHES	FLOW RATE GPM	PRESSURE LOSS PSI
2	160	8.5
2½	225	9.2
3	320	6.4
4	800	8.0
6	1000	8.1
8	1600	6.0

DIMENSION TABLE

SIZE	2" SCR	2" FLG	2½	3	4	6	8	10
A END TO END	29¼	33	42 3/16	42 3/16	48¼	61¼	74	86
AA LESS G.V.	22 3/16	20⅛	27 3/16	26 3/16	30⅛	40⅛	50¾	59½
B OVERALL WIDTH	12¾	12¾	13½	15 3/16	20 3/16	22½	26¾	30⅛
C CENTER TO TOP	8½	8½	13½	15	17½	20¾	25	29½
D CENTER TO BOTTOM	2	2	3	3	3½	4½	5¾	8
E CENTER TO OUTSIDE	9¾	9¾	11 11/16	11 11/16	14 5/16	16	17	19¾
TEST COCKS	¼	¼	½	½	½	¾	¾	¾

** Maximum Dimensions*

Shut-off Valves on 2" are rising stem.

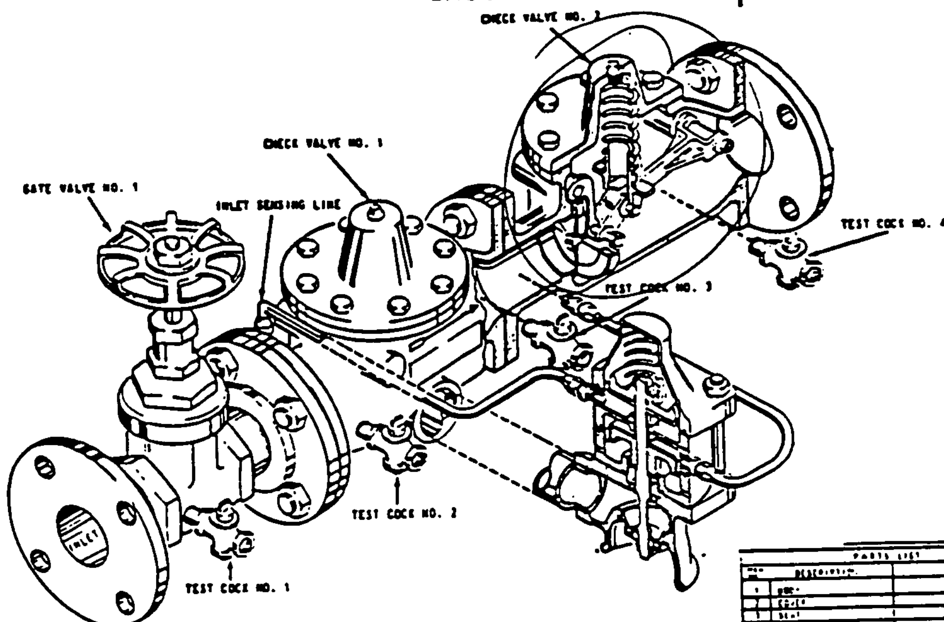
Shut-off Valves on 2½" & larger: Are standard non-rising stem

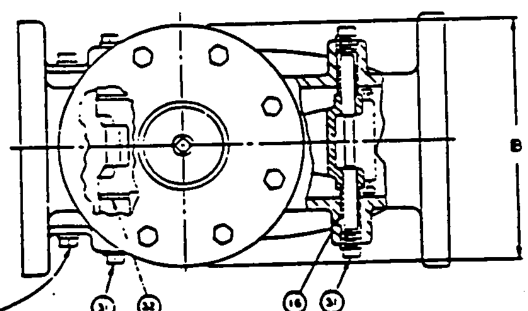
CLAYTON *automatic* VALVES

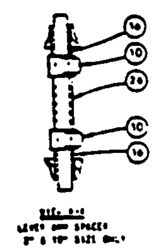
INSTALLATION/OPERATION/MAINTENANCE

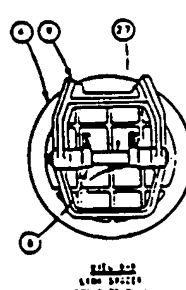
BACKFLOW PREVENTER

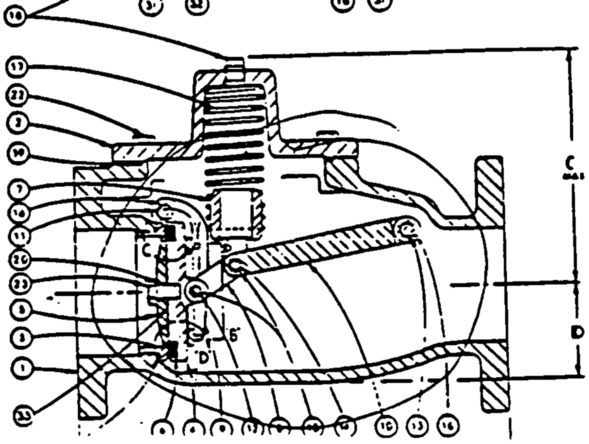
Clayton **RP**

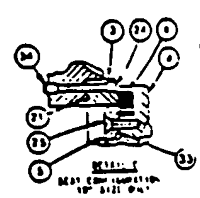


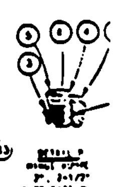








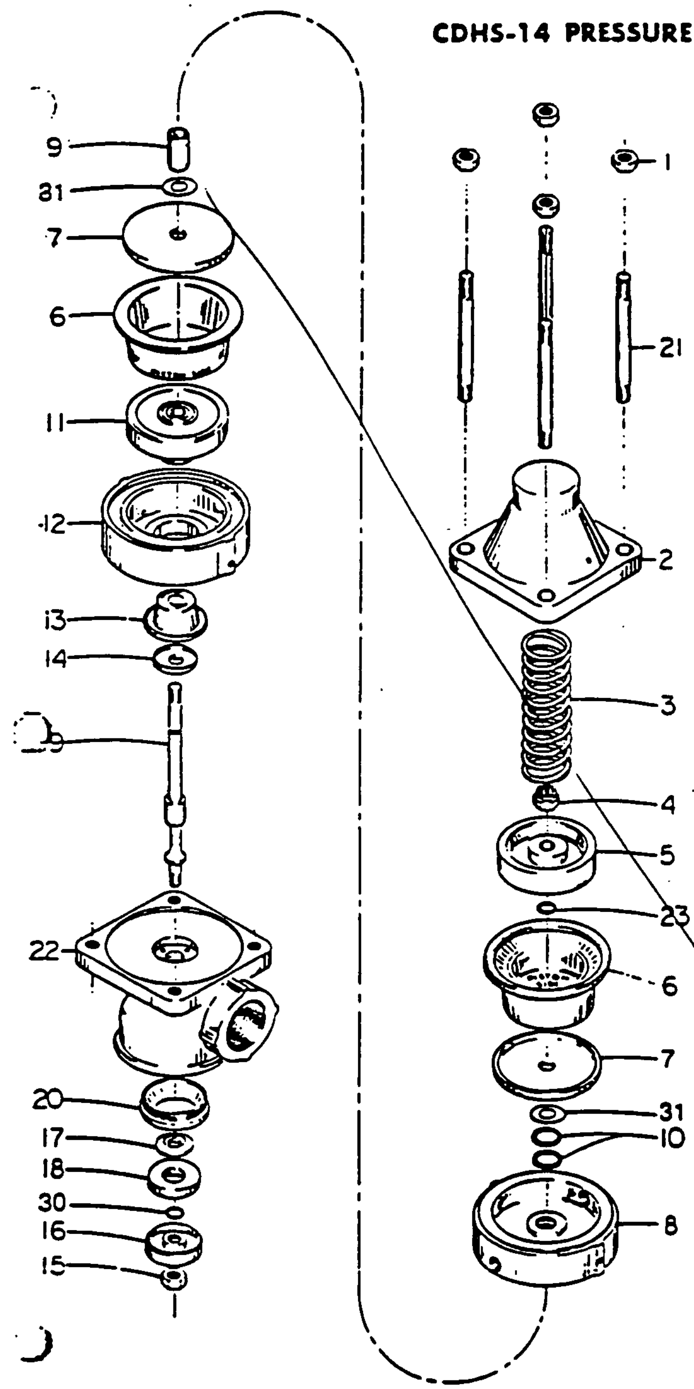




PARTS LIST		
[illegible]	DESCRIPTION	REMARKS
[illegible]	[illegible]	[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

CDHS-14 PRESSURE DIFFERENTIAL RELIEF VALVE



1" and 1¼" SHOWN BELOW

PARTS LIST

ITEM NO.	DESCRIPTION
1	STUD NUTS
2	VALVE COVER
3	SPRING
4	STEM NUT
5	UPPER PISTON
6	LARGE DIAPHRAGM
7	LARGE DIAPHRAGM RETAINER
8	INTERMEDIATE PLATE
9	SPACER
10	"O" RING
11	LOWER PISTON
12	CYLINDER
13	SMALL DIAPHRAGM
14	SMALL DIAPHRAGM RETAINER
15	STEM NUT
16	DISC RETAINER
17	DISC GUIDE
18	DISC
19	STEM
20	SEAT
21	STUDS
22	BODY
23	"O" RING
30	"O" RING
31	GASKET

CLA VAL RPI / RPI-EX

SIZE

2", 2½", 3", 4", 6", 8", 10"

DESCRIPTION

The model RPI is Cla Val's present state of the art in large size reduced pressure backflow preventers. The valve consists of two epoxy coated cast iron body toggle lever check valves and a bronze body pressure differential relief valve located between the two checks. There are two styles of check rubbers and the serial numbers are needed in order to differentiate them. Devices ordered after 1986 are named RP1-EX, the repair parts are the same as the RPI. The difference was the redesigning of the relief valve below the check assy. Dimensions are shown on page 65A.

RECOMMENDED REPAIR PARTS

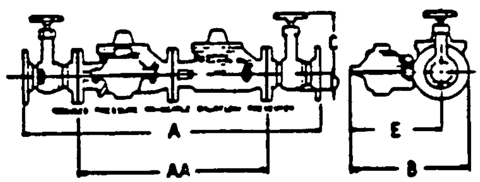
The repair kit contains rubber disc, diaphragm, gaskets, and O'rings.

SIZE	PART NO.
2"	RP1-200*
2½"	RP1-250*
3"	RP1-300*
4"	RP1-400*
6"	RP1-600*
8"	RP1-800*
10"	RP1-001*

Separate repair kits can be ordered for check assembly and relief valve sections.

CLA-VAL CO. | BACKFLOW PREVENTER | MODEL RP-1

DIMENSIONS



SPECIFICATIONS

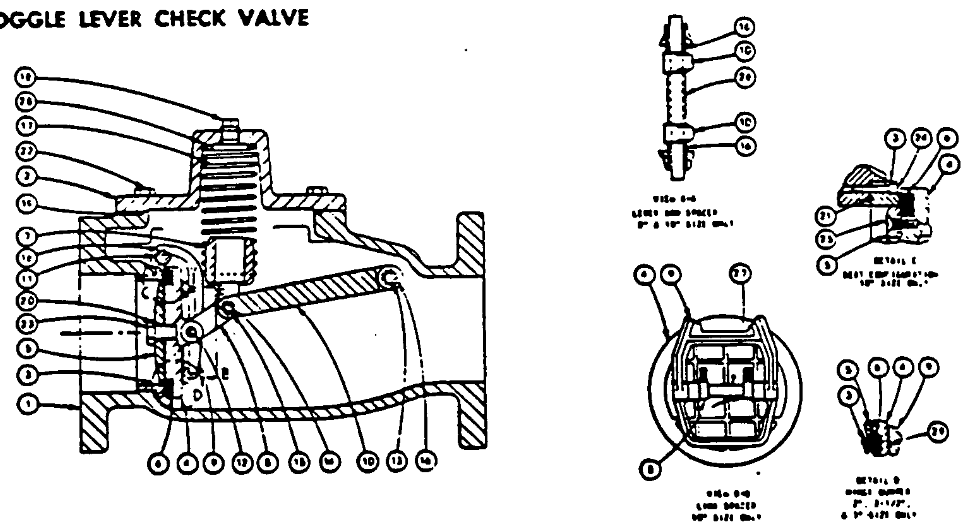
SIZES	2"- 10"
END DETAIL	125 ANSI
MAXIMUM WORKING PRESSURE	150 PSI
HYDROSTATIC TEST PRESSURE	300 PSI
TEMPERATURE RANGE	to 110°F.
FLUID	Water
MATERIAL	*2" main valve body and cover:* Bronze ASTM B-61 *2½" and larger main valve body and cover:* Cast Iron ASTM A-126 interior epoxy coated *Main valve trim:* Bronze ASTM B-61 *Differential relief valve:* Bronze ASTM B-61 with Stainless Steel 316 Trim

DIMENSION TABLE

SIZE	2" SCR	2" FLG	2½	3	4	6	8	10
A END TO END	29¼	33	42 3/16	42 3/16	48¼	61¼	74	86
AA LESS S.V.	22 3/16	20¼	27 3/16	26 3/16	30¼	40⅛	50¼	59⅛
B OVERALL WIDTH	12¾	12¾	15½	15 3/16	20 3/16	22½	26¾	30⅞
C CENTER TO TOP	8½	8½	13⅝	15	17½	20¾	25	29½
D CENTER TO BOTTOM	2	2	3	3	3½	4½	5¾	8
E CENTER TO OUTSIDE	9¾	9¾	11 11/16	11 11/16	14 13/16	16	17	19⅜
TEST COCKS	¼	¼	½	½	½	¾	¾	¾

SHUT-OFF VALVES ON 2" ARE RISING STEM.
SHUT-OFF VALVES ON 2½" & LARGER ARE NON-RISING STEM STANDARD

TOGGLE LEVER CHECK VALVE



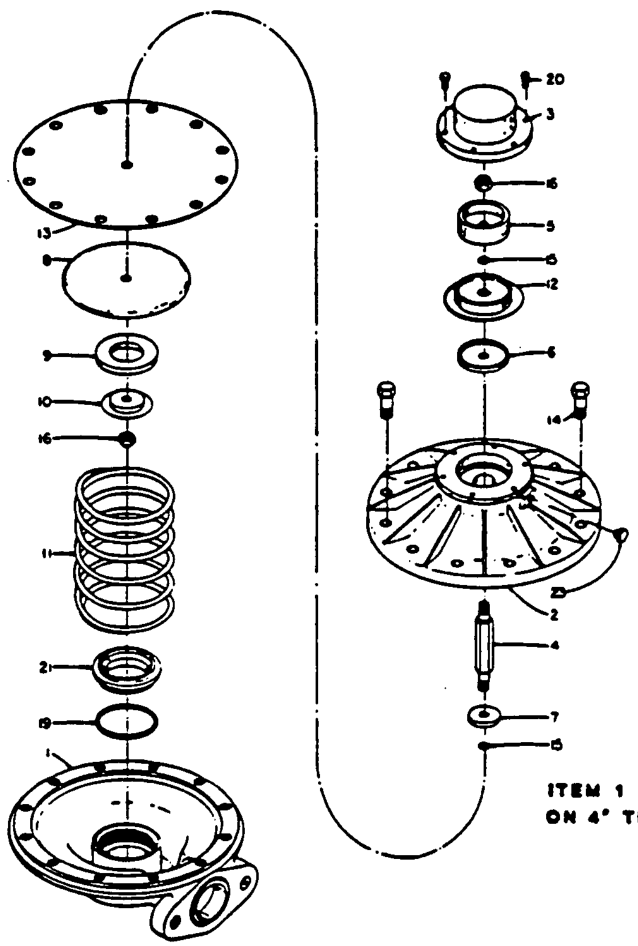
PARTS LIST
When ordering parts specify Item No., Description, all name Plate data, and valve size

ITEM NO.	DESCRIPTION	ITEM NO.	DESCRIPTION	ITEM NO.	DESCRIPTION
1	BODY	13	LEVER ARM PIN	22	CAP SCREWS
2	COVER	14	LINK PIN	23	DISC GUIDE BOLT (1" THRU 8")
3	SEAT	15	PIN RETAINER	24	SEAT SCREW (10" ONLY)
4	DISC RETAINER	16	BUSHING	25	DISC GUIDE SCREW (10" ONLY)
5	DISC GUIDE	17	SPRING	26	LEVER ARM SPACER (8" & 10" ONLY)
6	DISC	18	PLUG	27	LINK SPACER (10" ONLY)
7	YOKE	19	COVER SEAL	28	SPRING WASHER (2" ONLY)
8	LINK	20	DISC GUIDE "O" RING (4", 6", 8" ONLY)	[illegible]	HINGE BUMPER (2", 2½"
9	HINGE	[illegible]	SEAT ... [illegible]		
10	LEVER ARM				

CDHS 20

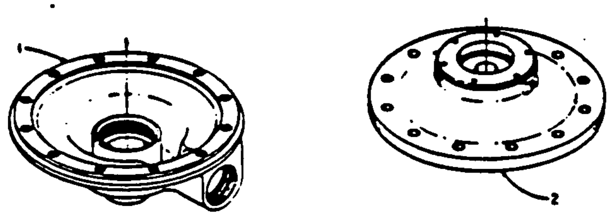
PRESSURE DIFFERENTIAL RELIEF VALVES FOR RP-1 BACKFLOW PREVENTER

ALL PARTS TYPICAL EXCEPT AS NOTED



ITEM NO.	DESCRIPTION
1	Body
2	Intermediate Body
3	Cover
4	Stem
5	Piston
6	Retainer Plate
7	Diaphragm Washer
8	Disc Retainer
*9	Disc
10	Disc Guide
11	Spring
*12	Rollofram
*13	Diaphragm
14	Hex Head Screw
*15	Stem O-Ring
*16	Self Locking Nut
19	Seat O-Ring.
20	Fil Head Screw
21	Seat
*23	Pipe Plug

ITEM 1 & 2 SHOWN FOR USE ON 4" THRU 10" MODEL RP-1

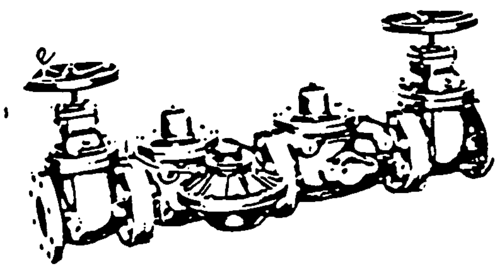


ITEM 1 & 2 SHOWN FOR USE ON 2" THRU 3" MODEL RP-1

MODEL RPI

REDUCED PRESSURE PRINCIPLE

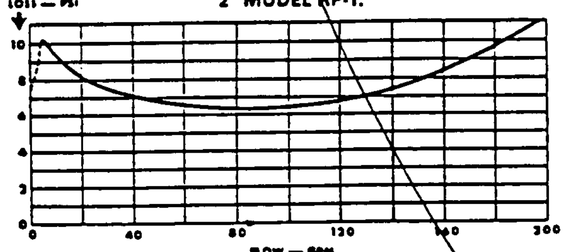
Sizes 2" through 10"



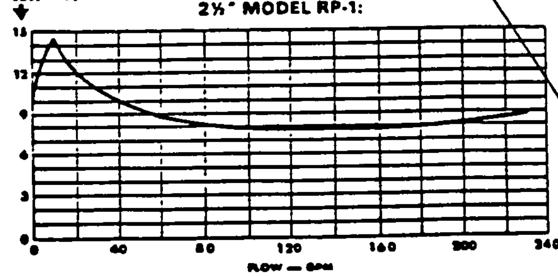
4" size illustrated

FLOW CURVES

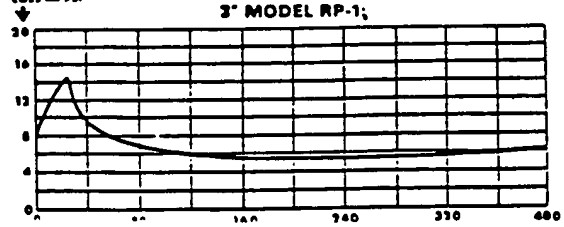
2" MODEL RP-1:



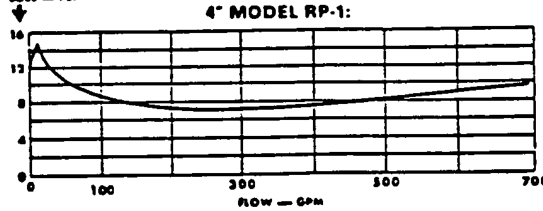
2½" MODEL RP-1:



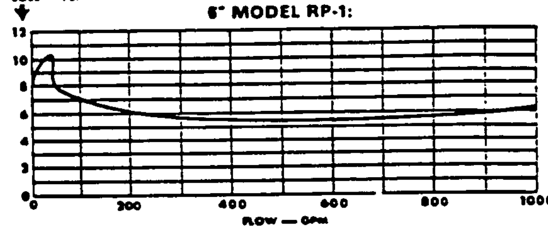
3" MODEL RP-1:



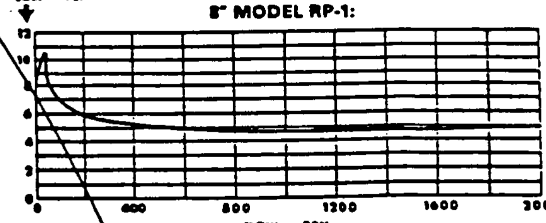
4" MODEL RP-1:



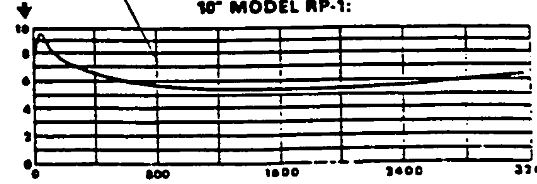
6" MODEL RP-1:



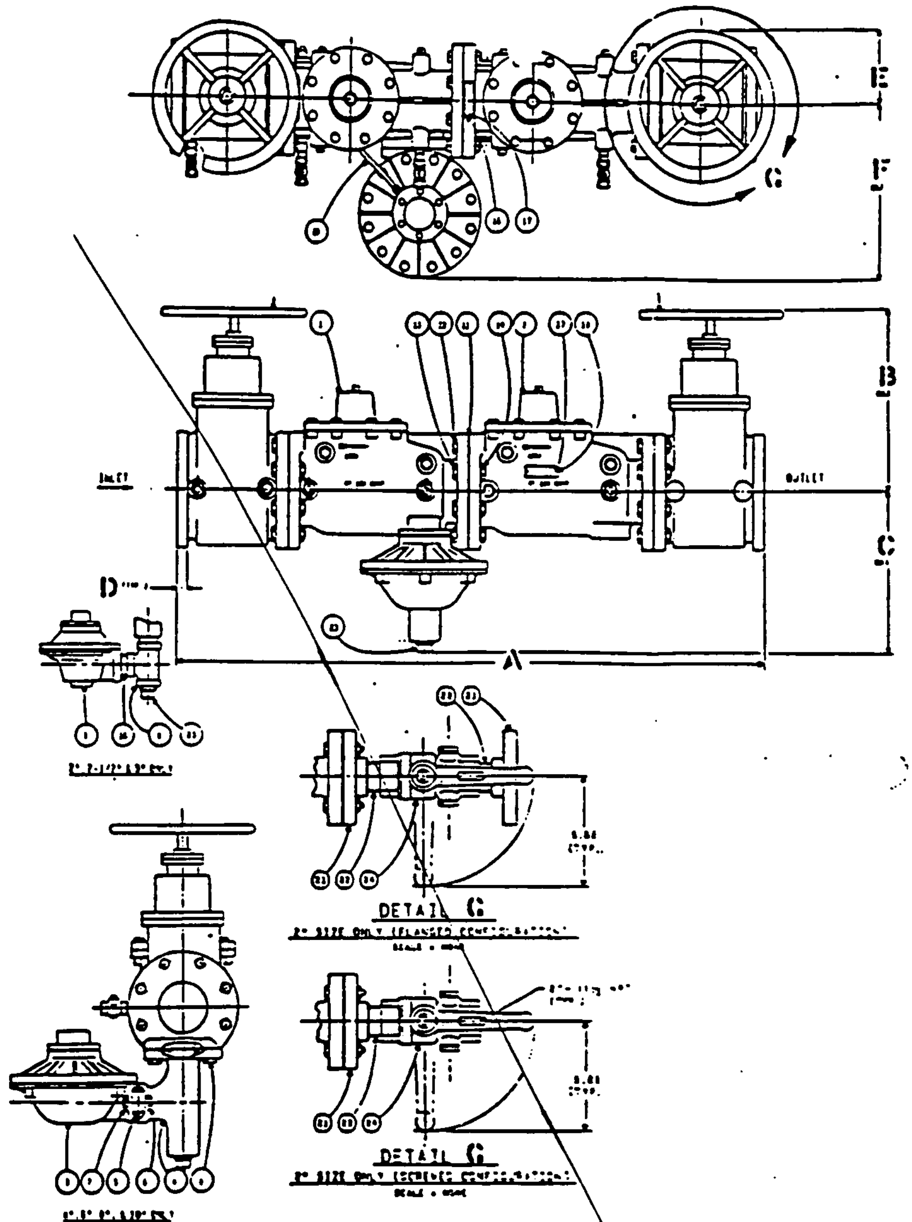
8" MODEL RP-1:



10" MODEL RP-1:



RPI-EX



DIMENSION TABLE

SIZE	2"	2"	2-1/2"	3"	4"	6"	8"	10"
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	—	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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[illegible]	[illegible]	[illegible]	[illegible]					
[illegible]	[illegible]	[illegible]	[illegible]					

CLA VAL RP2

SIZE

3/4", 1", 1¼", 1½"

DESCRIPTION

The model RP 2 is Cla Val's present state of the art in small size reduced pressure backflow preventers. The valve is of bronze construction and consists of two poppet type check valves with a pressure differential relief valve located between the two check valves. All parts are available for proper repairs and maintenance.

RECOMMENDED REPAIR PARTS

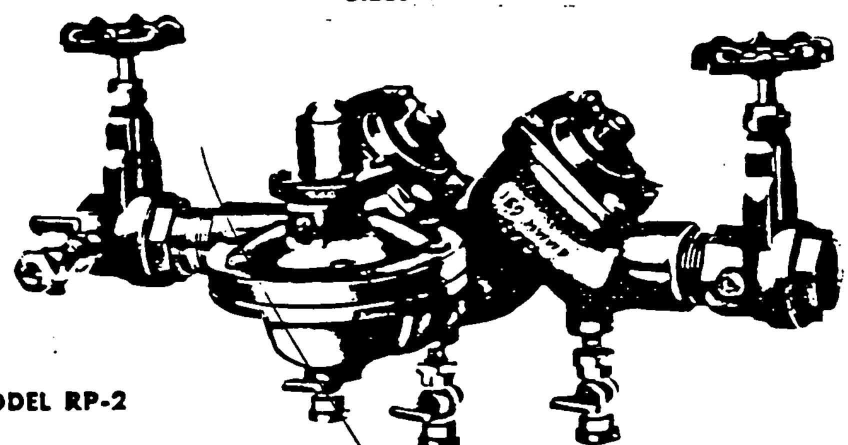
The repair kit contains rubber disc, diaphragm, gasket and O'rings.

SIZE	PART NO
3/4"-1"	RP2-100 *
1¼"-1½"	RP2-150 *

Separate repair kits can be ordered for check assemblies and relief valve sections.

CLA-VAL CO. BACKFLOW PREVENTER

Sizes ¾" - 1" - 1¼" - 1½"



MODEL RP-2

REDUCED PRESSURE PRINCIPLE

The Model RP-2 Backflow Preventer combines maximum protection against backflow with exceptionally low head loss characteristics. It operates on the reduced pressure principle, which is an accepted method of safeguarding potable water supplies against the hazards of cross-connections.

The Model RP-2 assembly is carefully constructed of corrosion-resisting materials. It consists of two independently acting Poppet-Type Check Valves, an automatic Pressure Differential Relief Valve located between the two check valves, two shut off valves and four test cocks.

Field testing is easily performed by means of the test cocks.

This Unit must be installed in a horizontal position with the Relief Valve discharging vertically down.

FEATURES

- Positively protects potable water lines against the hazards of backflow due to cross connection.
- Designed to meet the requirements of: Foundation for Cross Connection Control and Hydraulic Research; AWWA Standard C506.

OPERATION

When a normal flow condition exists, both Check Valves are open and the Pressure Differential Relief Valve is closed. No pressure adjustments are required. The unit operates efficiently at either high or low pressure. The Flow Charts, opposite side, show the slight pressure drop obtained at rated flow.

When flow ceases, pressure in the zone between the Check Valves is maintained at least 2 psi lower than inlet pressure. Should inlet pressure drop to 2 psi or less, the Pressure Differential Relief Valve opens the zone to atmosphere.

Should a backflow condition exist, the Pressure Differential Relief Valve will open to maintain the zone pressure at least 2 psi less than the inlet pressure.

CAUTION: PROVISION FOR ADEQUATE DRAINAGE MUST BE PROVIDED

SPECIFICATIONS

SIZES	*¾" through 1½"*
END DETAIL	*Screwed:* ANSI B 16.15
MAXIMUM WORKING PRESSURE	150 PSI
HYDROSTATIC TEST PRESSURE	300 PSI
TEMPERATURE RANGE	to 110°F
FLUID	Water
MATERIAL	*Main valve body and cover:* Bronze ASTM B-61 *Main valve trim:* Bronze ASTM B-61 & Delrin *Differential relief valve:* Bronze ASTM B-61 with Stainless Steel 316 Trim

PRESSURE DIFFERENTIAL RELIEF VALVE

This valve is a balanced differential valve which opens on a decreasing differential. It is closed whenever the inlet pressure is 2 to 3 psi higher than the zone pressure. When the difference in pressure is less than 2 psi, the valve begins to open and will continue to open wider as the differential decreases. Thus, the zone pressure is maintained less than the inlet pressure.

Right hand mount standard—Left hand mount available upon request.

FEATURES

- Positive automatic operation
- Single seat . . . tight shutoff . . . resilient disc
- Valve outlet cannot be interconnected or plugged
- All parts corrosion resistant

PURCHASE SPECIFICATIONS

The reduced pressure principle backflow preventer shall consist of two independently acting spring-loaded check valves, an automatically operating pressure differential relief valve, tightly closing shutoff valves located at each end of the device, and shall be fitted with properly located test cocks. Operation shall be completely automatic. All internal parts of the spring-loaded check valves and the pressure differential relief valves must be removable or replaceable without removal of the backflow preventer from the line. The total head loss through the complete backflow preventer assembly shall not exceed — (select value as shown in the flow table) ⟶

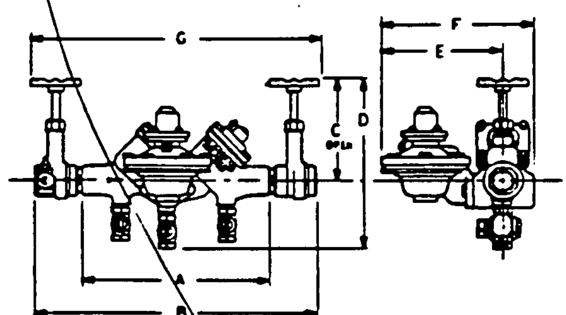
The reduced pressure principle backflow preventer shall be similar in all respects to the Model RP-2 Backflow Preventer as manufactured by Cla-Val Co., Newport Beach, California, 92663, or approved equal.

VALVE SIZE IN INCHES	FLOW RATE IN GPM	PRESSURE DROP IN PSI
¾	30	12.8
1	50	12.25
1¼	75	13.2
1½	100	13.5

DIMENSIONS

	A	B	C*	D	E	F	G	APPROX. SHIP. WT.	TEST COCKS
¾"	10.12	15.00	4.06	7.50	6.00	7.50	15.38	18	¼
1"	9.00	13.68	5.19	8.62	6.00	7.50	13.93	19	¼
1¼"	13.25	18.62	6.06	10.06	6.12	7.81	18.88	29	¼
1½"	11.75	18.12	7.06	11.06	6.12	7.81	18.88	30	¼

*Shutoff Valves are Rising Stem



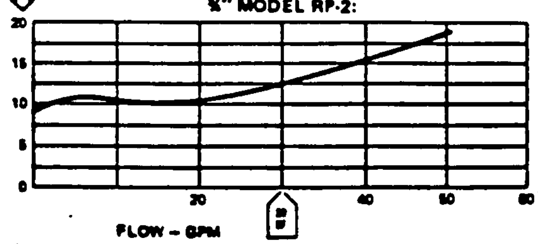
Dim w/ Ball Valve

Size	B
¾	17.38
1"	17.00
1¼"	21.62
1½"	20.44

FLOW CURVES

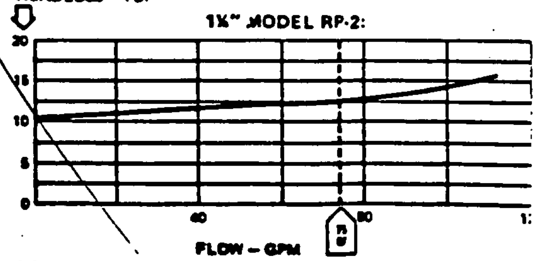
HEADLOSS – PSI

¾" MODEL RP-2:



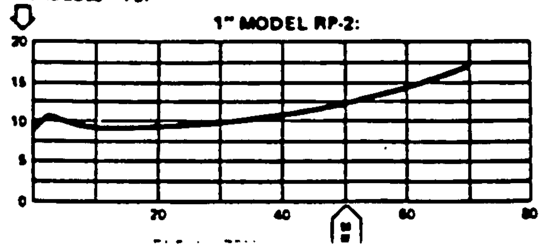
HEADLOSS – PSI

1¼" MODEL RP-2:



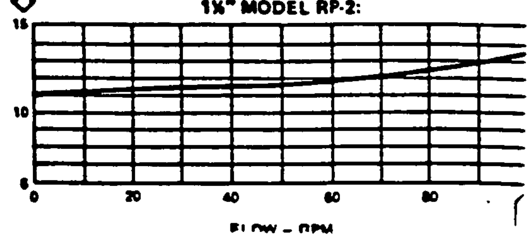
HEADLOSS – PSI

1" MODEL RP-2:

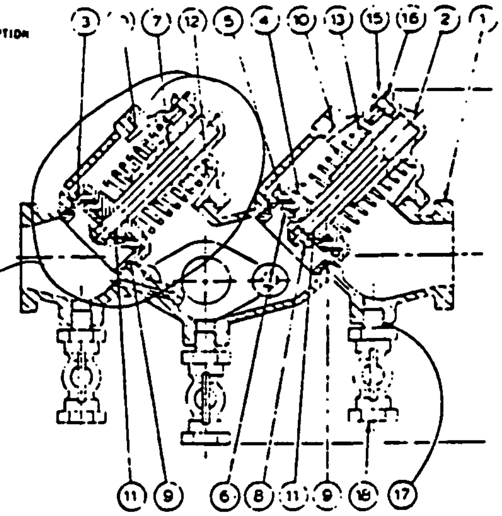


HEADLOSS – PSI

1½" MODEL RP-2:

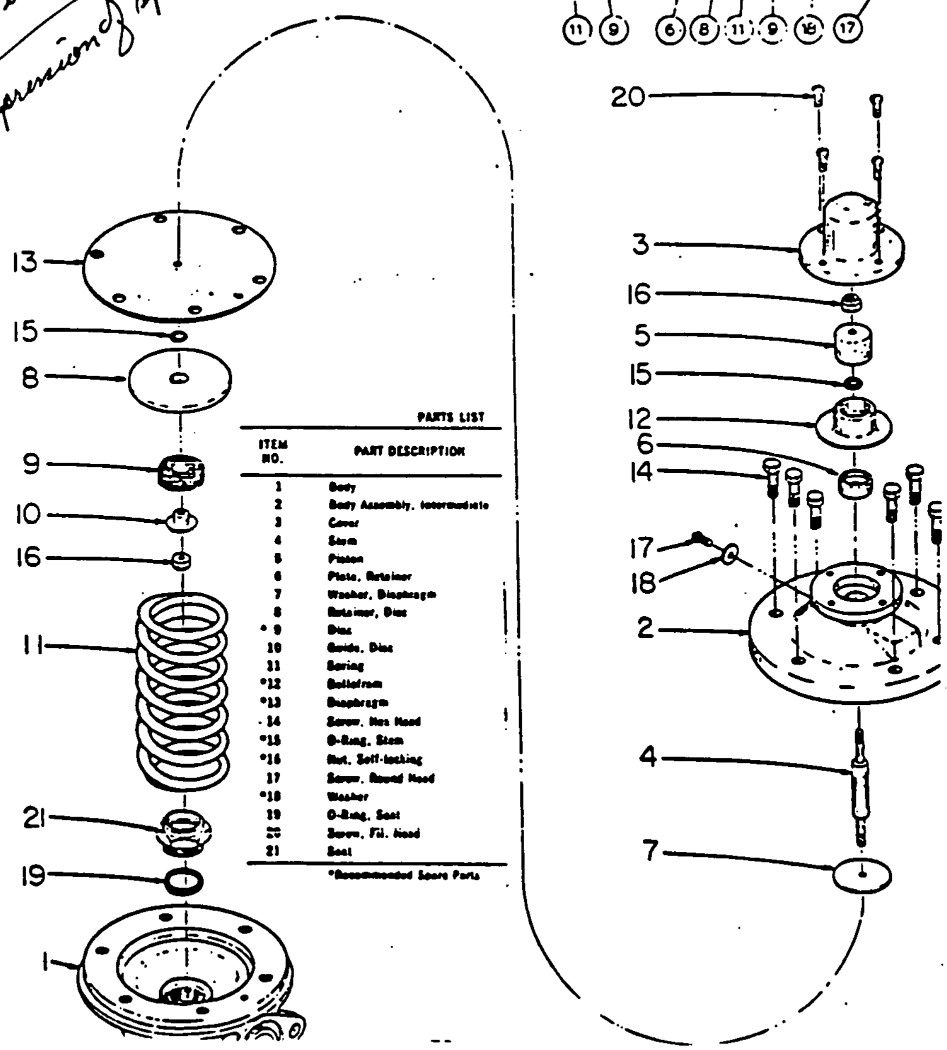


ITEM NO.	PART DESCRIPTION
1	Body
2	Cover Assembly
3	Seat
4	Disc Retainer
*5	Disc
6	Disc Guide
7	Stem
*8	Nut, Self-locking
9	O-Ring, Seat
*10	O-Ring, Cover
*11	O-Ring, Stem
12	Spring, #1 Check
13	Spring, #2 Check
14	Bolt, Hex Head
15	Screw, Round Head
*16	Washer
17	Nipple, Close
18	Cock, Plug Type
*19	Gasket
20	Cover, Flange
21	Bolt, Hex Head



Model RP-2
Sizes ¾" thru 1½"

Center guided.
Like some of our existing model.
NOTE direct compression of spring



PARTS LIST

ITEM NO.	PART DESCRIPTION
1	Body
2	Body Assembly, Intermediate
3	Cover
4	Stem
5	Piston
6	Plate, Retainer
7	Washer, Diaphragm
8	Retainer, Disc
*9	Disc
10	Guide, Disc
11	Spring
*12	Bellofram
*13	Diaphragm
14	Screw, Hex Head
*15	O-Ring, Stem
*16	Nut, Self-locking
17	Screw, Round Head
*18	Washer
19	O-Ring, Seat
20	Screw, Fil. Head
21	Seat

*Recommended Spare Parts

CLA VAL D

SIZE

2",2½",3",4",6",8",10"

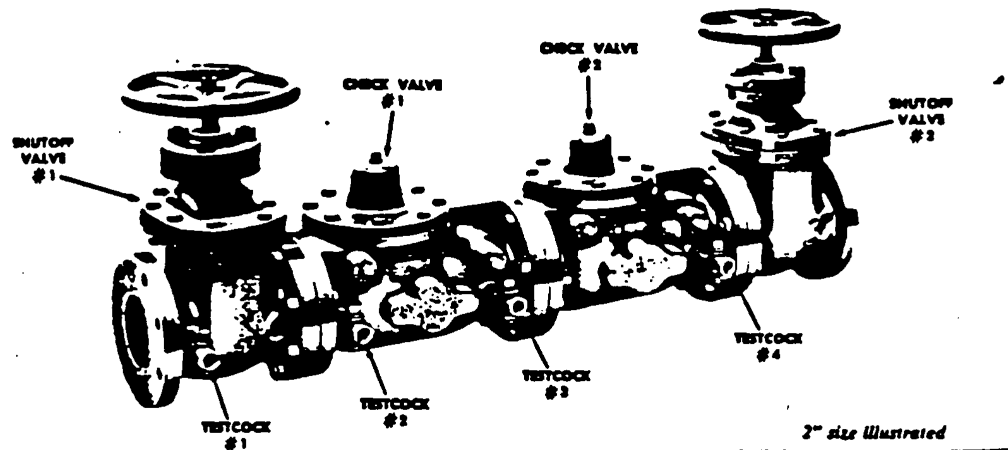
DESCRIPTION

The model D is Cla-Val's present state of the art in large size double check backflow preventers. The 2" valve is of bronze body construction. The 2½"-10" size is a cast iron body with the interior epoxy coated to minimize rust growth. The checks are of a toggle lever type designed and used by Cla Val exclusively.

RECOMMENDED REPAIR PARTS

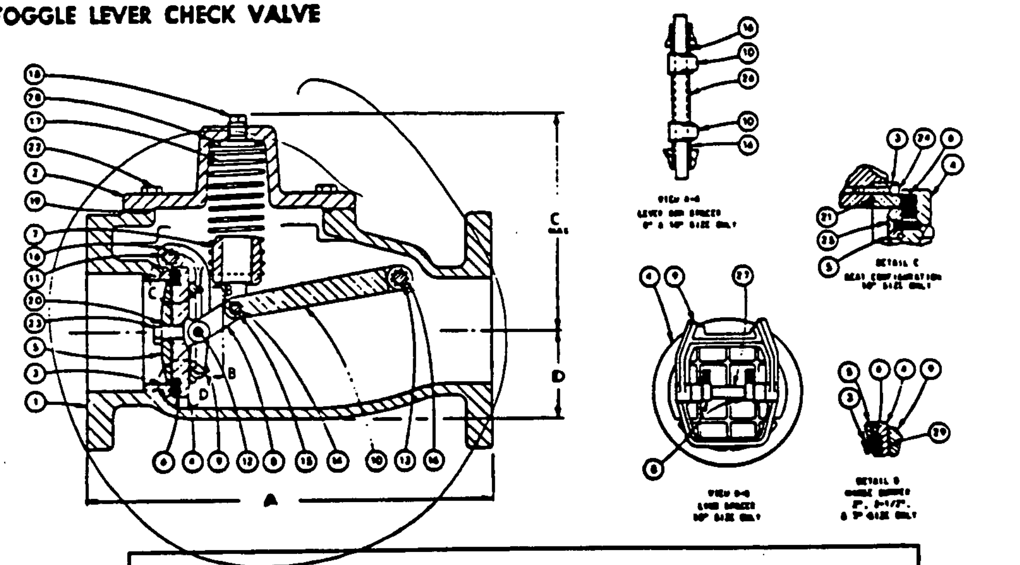
The repair kit contains rubber discs and cover seals.

SIZE	PART NO
2"	D00-200 *
2½"	D00-250 *
3"	D00-300 *
4"	D00-400 *
6"	D00-600 *
8"	D00-800 *
10"	D00-001 *



2" size Illustrated

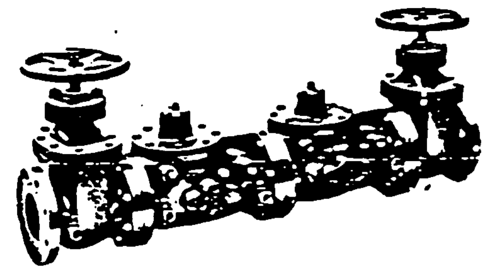
TOGGLE LEVER CHECK VALVE



PARTS LIST

When ordering parts specify Item No., Description and all Name Plate data.

ITEM NO.	DESCRIPTION	ITEM NO.	DESCRIPTION	ITEM NO.	DESCRIPTION
1	BODY	13	LEVER ARM PIN	22	CAP SCREWS
2	COVER	14	LINK PIN	23	DISC GUIDE BOLT (1" THRU 8")
3	SEAT	15	PIN RETAINER	24	SEAT SCREW (10" ONLY)
4	DISC RETAINER	16	BUSHING	25	DISC GUIDE SCREW (10" ONLY)
5	DISC GUIDE	17	SPRING	26	LEVER ARM SPACER (8" & 10" ONLY)
6	DISC	18	PLUG	27	LINK SPACER (10" ONLY)
7	YOKE	19	COVER SEAL	28	SPRING WASHER (2" ONLY)
8	LINK	20	DISC GUIDE "O" RING (4", 6", 8" ONLY)	29	HINGE BUMPER (2", 2½" & 3" ONLY)
9	HINGE	21	SEAT "O" RING (10" ONLY)		
10	LEVER ARM				
11	HINGE PIN				
12	DISC RETAINER PIN				



4" size Illustrated

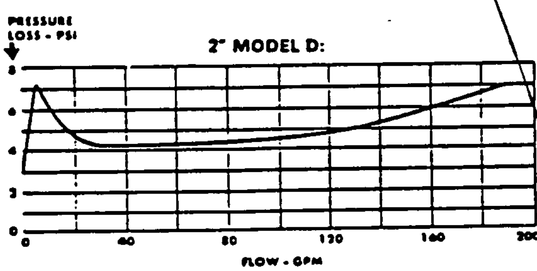
MODEL D

DOUBLE CHECK VALVE ASSEMBLY

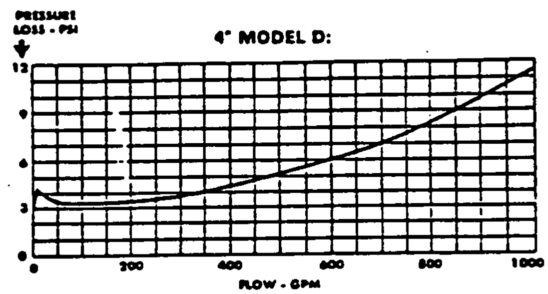
Sizes 2" through 10"

FLOW CURVES

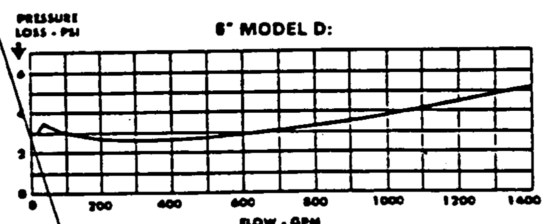
2" MODEL D:



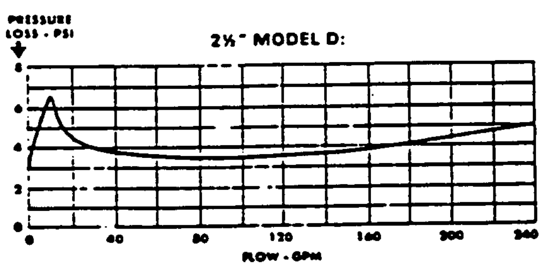
4" MODEL D:



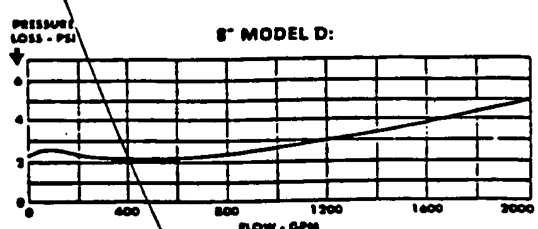
6" MODEL D:



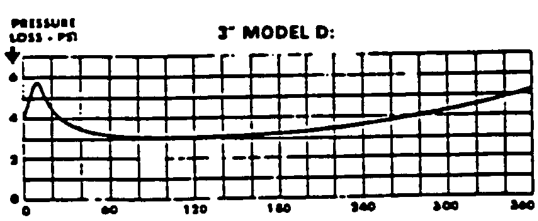
2½" MODEL D:



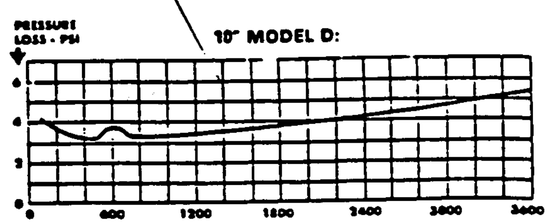
8" MODEL D:



3" MODEL D:



10" MODEL D:



CLA VAL D2

SIZE

3/4", 1", 1¼", 1½"

DESCRIPTION

The model D-2 is Cla Val's present state of the art in double check backflow preventers from 3/4" to 1½" size. The valve is a bronze body with poppet type check valves.

RECOMMENDED REPAIR PARTS

The repair kit contains rubber discs and cover gaskets.

SIZE	PART NO
3/4"-1"	D20-100 *
1¼'-1½"	D20-150 *

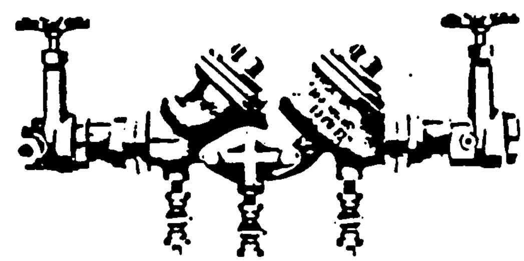
CLAYTON *automatic* **VALVES** | **BACKFLOW PREVENTER** | ***Clayton* D-2**

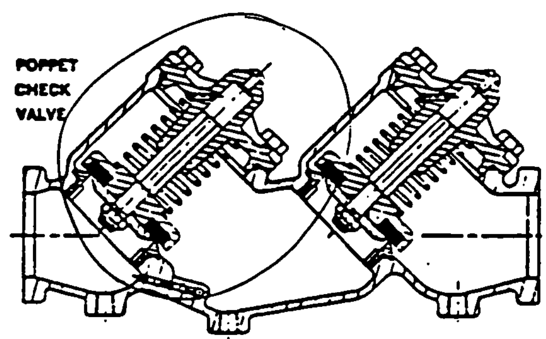
The Clayton D-2 Double Check Valve Assembly is a reliable means of backflow protection for intermediate degrees of hazard. The assembly is carefully constructed of corrosion resisting materials. It consists of one body containing two independently acting spring-loaded poppet check valves, two gate valves and four test cocks. Field testing is easily performed by means of the test cocks provided for this purpose.

The poppet check valves are uniquely designed to provide drip-tight closure against reverse flow, and low pressure drop at maximum capacity. The spring-loaded poppet causes the valve to seal against an inlet pressure higher than the outlet pressure when there is no flow.

It is recommended that this unit be installed in a horizontal position. All internal parts are readily accessible without removing valves from the line.

DOUBLE CHECK VALVE ASSEMBLY

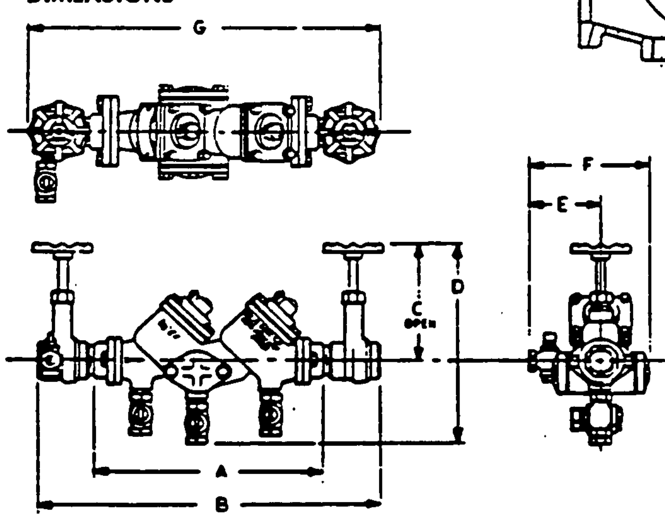




FEATURES

- Low head loss
- No internal or external weights
- All parts are corrosion resistant
- Positive operation without chattering

DIMENSIONS



SPECIFICATIONS

VALVE SIZES	¾", 1", 1¼" & 1½"
END DETAILS	*Screwed:* ANSI B 16.15
WORKING PRESSURE	*Maximum:* 150 psi
HYDROSTATIC TEST	*Pressure:* 300 psi
TEMPERATURE RANGE	to 110°F
FLUID	Water
MATERIALS	*Check valve body and cover.* Bronze ASTM B-61 *Check valve trim:* Bronze ASTM B-61

DIMENSIONS IN INCHES

Valve Size	A	B	C	D	E	F	G
¾"	9.38	12.56	4.06	7.50	2.00	4.72	12.81
1"	9.38	14.06	5.19	8.62	2.00	4.94	14.31
1¼"	12.06	17.56	6.06	10.06	2.19	5.38	17.81
1½"	12.12	17.88	7.06	11.06	2.19	5.44	18.62

Gate Valves are rising stem

CLA-VAL CO.

CLA VAL 16

SIZE

3",4",6",8",10"

DESCRIPTION

The model 16 double check assembly is for use on fire protection systems. It consists of a Model D backflow preventer with a by pass meter and 3/4" Model D-2 after the meter.

RECOMMENDED REPAIR PARTS

The repair kits consist of rubber discs and cover gaskets.

SIZE	PART NO
3"	D00-300 *
4"	D00-400 *
6"	D00-600 *
8"	D00-800 *
10"	D00-001 *

When by pass double check is to be repaired order kit below.

3/4"	D20-100 *

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